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Nutrition Advisory Committee.

BY the inauguration of the Nutrition Advisory Committee, His Excellency the Viceroy has focussed public attention and enlisted the sympathy of the leaders of public life in favour of the vital problems of human and animal nutrition. In his opening speech H. E. Lord Linlithgow laid particular stress on the application of the researches of the nutrition laboratories to the food habits of the people as well as to those of animals in their service, in close collaboration with the investigations of the agricultural departments. The question of nutrition has been arousing increasing public interest in the last three decades, as a result of social and scientific progress, and the health organisation of the League of Nations has been engaged in investigating certain aspects of this subject for several years. It will be remembered that at the public session of the League Assembly in 1935, a discussion took place on the relation of nutrition to public health on the one hand and to economic and social problems on the other, resulting in the adoption of a series of resolutions urging Governments to examine the practical means of securing better nutrition. Writing on Nutrition Research in India,[1] we observed that

> "The question of feeding India for national efficiency is sufficiently important to warrant the creation of certain new departments such as the Bureau of Food Economics and the Agriculture Adjustment Board which would have to work in closer collaboration with the Nutrition Research Laboratories at Coonoor and with the Provincial Agricultural Departments. The first step is to work out a set of figures showing the amount of land that would have to be devoted to various food crops for each of the dietary plants, assuming that they will be universally used by the Indian population. These figures will naturally include not only crops used directly for human food but also crops necessary to feed the required dairy and work animals. A close

[1] *Curr. Sci.*, April 1935, **3**, 10.

relationship has thus to be established between dietary habits and agricultural practice."

We have always emphasised that the problems of public health are more intimately connected with the nutrition of the people and the agricultural policy of the State than with the prevention of diseases, and this view is in accordance with the results of medical researches which establish that most of the maladies which afflict man arise from lack of resistance produced by malnutrition. The institution of the Nutrition Advisory Board which includes experts of agricultural and veterinary science, linked up with the Scientific Advisory Board of the Indian Research Fund Association, must remove the general criticism that " the agricultural policy in India is not correlated with the science of nutrition " and must be the outcome of the recognition of the fact that the problems of public health, human and animal nutrition and of agriculture " vitally constitute the elements of a single great administrative policy".

The primary task of the Nutrition Advisory Board will be to formulate easily understood principles on which the scientific control of the production and distribution of food to the nation must be founded, and to institute a machinery for popularising these principles. For the purpose of ensuring an equable and equitable distribution of food, it may be necessary for the State to assume the responsibility of controlling the production of food in the country and its retail and wholesale distribution. The dietary change intended to be introduced is an enlightened reform of the habits and appetites of the people, and if the reason for the change is understood, there must be ready acquiescence even by those who are put to the most inconvenience. The problem of animal nutrition introduced for the first time in India, is not likely to land in the question of man *versus* animal ; human food in the form of cereals and potatoes may not be employed for fattening animals to the extent of diminishing their supply for man's consumption. On the other hand, the Board ought to indicate the policy of increasing, as far as possible, the food available for man by planting more disease-free cereals, by ploughing up grass lands for wheat and rice cultivation, and by increasing the culture of potatoes. The collection of carefully tested information about nutrition understood by the average person and about dietary standards suited to different levels of income is the province of experts in land economics, who will have to compare nutritional standards and requirements, the nutritive values of common foods and the cost of their supply. The patterns of diet based on their investigations for the different classes of people and tested by the Public Health Department, should take the form of broad specifications permitting adequate room for individual family selection. It seems to us that the Nutrition Advisory Board should have included in its personnel a food economist and a physiologist whose expert knowledge and guidance are almost indispensable in dealing with the extensive and complicated programme of work undertaken.

Before the Board produces a scheme for dietary plans in relation to incomes, its investigations in India will presumably be based more or less on the lines analogous to those of the Bureau of Agricultural Economics and the Agricultural Adjustment Administration in the United States, dealing with Agricultural production and land use. The information collected by these bodies embraces the scientific results regarding the nutrition values and standards, the practical adoption of these findings into the daily meals of the people, the relation of public welfare to the people's diet and the capacity of land for producing the requisite quantity and quality of food. It ought to be the function of the food economist to investigate the family budgets and fix the prices of the different articles, and even seek for legislative sanction against stocking and for enforcing sales at non-remunerative prices. When complete and sufficiently simple and flexible plans have been prepared, the Nutrition Advisory Board has to employ all the devices of propaganda for popularising the results of their labours for national benefit.

The need of building up a physically stronger, healthier and more efficient population by means of better nutrition has been engaging the attention of Governments for the past thirty years, and that need is obviously the result of the play of forces in modern civilisation. Its problems are machinery and money, its conflicts, labour and capital, its ideals, records and impatience and its achievements, poor health and weak stomach. It should be remembered that the

alimentary system is the one organ that comes periodically into immediate contact with the environment, and when man discovered the art of cooking, he practically laid the foundation of its functional alteration. Elaborate cooking and highly seasoned food have sophisticated human appetite, which can put forth new efforts only when food is sufficiently provocative. The part that the spice trade has played in international politics during the Stuart and later times is an example of the weakened stomach produced by sauces and the stress of competitive life. The Nutrition Advisory Board might give a most scientifically correct plan containing the proper amount of calories and a requisite amount of vitamins, and if the planned food is incapable of being digested and assimilated, its labours are futile. Modern civilisation has robbed the educated community of hunger, and what induces its people to eat is the force of habit, the monotony of which they attempt to relieve by resorting to the by-lanes and footpaths of alimentation provided by the eating houses, bar rooms and restaurants. The question of food did not trouble Governments and people before the invention of machinery, and since its appearance and progress, man has devoted more time to business than to food and sleep. Before the days of the industrial revolution he ate leisurely and slept peacefully. The continuous excitement and irritation of modern civilisation have placed food and sleep under the category of mild but necessary nuisances, and modern man loves and respects his business more than food and sleep. When the human mind is agitated by endless cares and worries it must inevitably react prejudicially on the natural sources of restoration and nourishment. This agitation commences from the age of five in the case of the educated communities, and continues till old age, and under the dispensation of compulsory education, people who are happily exempt from the influences of fretful civilisation, are proposed to be deprived of the care-free and peaceful life, under which they eat well and sleep well.

The stomach of the modern educated man, in whatever station he is placed, has lost much of its natural powers which distinguished his ancestors. The progress of material civilisation, as it affects the educated communities, seems to be almost in conflict with the physical health, hardihood and efficiency which characterised the generation belonging to the early Christian era. The question of nutrition is primarily the problem of the urban population on whom the pressure of all the complicated factors of the civilisation impinges. In the villages, open air, plenty of manual exertion, simple and unsophisticated food and occasional fasting, with few opportunities for excessive indulgence, keep the peasantry healthy and robust. Even when scientists prepare perfect diets for the inhabitants of towns, there remain the causes which have tended to weaken the stomach. These causes have to be removed or mitigated before the people can be expected to benefit by the labours of the Nutrition Advisory Board. It seems to us that what profits people most is not what they eat so much as how they eat. If food is loved and respected, eaten in leisure and peace, and in company and with mirth, it is capable of nourishing the body, provided it is also simple and wholesome. Modern civilised man lacks leisure, peace, open air, exercise and appetite. His sleep is banished by the agitating cares and anxieties of his business, his stomach is weakened by food, highly seasoned to whip up a jaded appetite. Such a man needs predisgested food. The physical growth of man proceeds under the constant and contemporary influence of his mind on the stomach, and this psychological factor is frequently ignored. The psychology of modern life has to be investigated before the nation can hope to profit by the results of nutrition researches.

The progress of work achieved by the Nutrition Advisory Board will be watched with keen interest by the public and we hope that, recognising the fact that national well-being is one of the categorical imperatives, the Board will be able to suggest the practical means of securing the objects for which it was brought into existence.

August Wilhelm von Hofmann, 1818-1892.

FOR those well past the meridian of life, a glimpse of early stages in a vast enterprise may have exceptional interest, because many of the later stages have come under their own observation. To a younger generation, such glimpses come as an inspiriting suggestion that seemingly unimportant occurrences, and sometimes even failures, may carry the germs of a great discovery, or conceal the foundations of a flourishing industry. From these two points of view the admirable Hofmann Memorial Lecture, lately delivered by Professor G. T. Morgan at the Imperial College of Science and Technology, will make a wide appeal.

It was appropriate that this lecture should have been delivered at the Imperial College, and by Professor Morgan. The chemistry department of the Imperial College is the lineal descendant of the Royal College of Chemistry founded in 1845 by Hofmann, who remained there as director until he returned to Germany in 1865. Professor Morgan's first appointment was in the famous Huddersfield dye-factory of Read Holliday and Sons, and although his direct contact with dye-making was broken for twenty years, his interest in that branch remained ardent, and in 1915 he rendered valuable service to the war-time isomeride of his old firm, which had then been renamed British Dyes, Limited. As might be expected, therefore, Professor Morgan's address provides an illuminating survey of Hofmann's contributions to coal-tar colour-chemistry, and elucidates the theoretical aspect of the organic branch prevailing in the 1860's.

Delicately, and perhaps wisely, it does not decide the paternity of the aniline-dye industry. While continental chemists have claimed this for Hofmann, British chemists have recognised the agency of W. H. Perkin. If dates alone are taken as the determining factor, the latter claim has the sounder foundation, because Perkin discovered mauve in 1856, while Hofmann's first preparation of rosaniline (fuchsine) was made in 1858. Moreover, Perkin was led by his discovery without delay to manufacture the product on a commercial scale, while Hofmann continued to manufacture chemists. Thus it is that, even if Hofmann was not the father of modern dye-making, he was undoubtedly the step-father, his pupils including Perkin himself, and the brilliant, but ill-fated Mansfield, along with Nicholson, Greville Williams, Caro, Martius, O. N. Witt and Griess, names which remain illustrious in the romantic history of this remarkable industry.

Furthermore, with so much heavy material for assemblage, Professor Morgan did not speculate on the origin of the early label for rosaniline, namely fuchsine. This dye was introduced commercially in 1859 by the French firm of Renard and Frank, so that *renard* the fox may have suggested the German *Fuchs*; alternatively, the lovely red colour of the then fashionable fuchsia may have inspired the dye-name.

Probably the general reader will find most attraction in the sections dealing with (1) the foundation of the Royal College of Chemistry in 1845, and (2) the development of Read Holliday and Sons. There is a queer element of the fortuitous in both events. In 1842 Justus von Liebig had visited England under the guidance of his former student at Giessen, Lyon Playfair, and after ample inspection of cities, and numerous contacts with bigwigs, had concluded that *England ist nicht das Land des Wissenschaftes.* Either the gibe or the contacts bestirred the natives, for the Prince Consort and the Queen's Physician, Sir James Clerk, were well supported in founding the Royal College of Chemistry, where, for the first time in England, chemistry became the main subject of study, instead of being a lowly handmaiden to medicine.

The development of Read Holliday and Sons, though free from pageantry, is more romantic. Born in 1809 at Bradford, Read Holliday began in 1830 to distil ammonia from gas-works liquor, and offered this new wool-cleanser to the manufacturers of Huddersfield, where he bought a strip of land on the river Colne and invited the local gas-works to dump its tar thereon. Thus he came to recognise the other volatile possibilities concealed by this unsavoury refuse, and in 1848 patented his naphtha-lamp, long used in gipsy-caravans and country-fairs. He became the owner of six tar-distilleries in the north of England and one in London, while Mansfield, just before his death in 1855, enabled Holliday to separate the benzenoid components in reasonable purity. The stage was now set for commercial application of Perkin's mauve, or aniline purple, discovered in

1856. The price of benzole rose to 20*s*. a gallon in 1860, when aniline was 20*s*. a pound.

Those were empirical days, and Professor Morgan's picture of Dan Dawson illuminates the period. This great Yorkshire personality was born in 1836 to a Huddersfield dyer, and his first 10 lb. of magenta, made in the kitchen-oven, not only realised £100 sterling, but coloured the succeeding loaves of bread. By 1874 he had made a fortune, and elected to study chemistry under Hofmann, whose researches had laid the foundation of his prosperity. Accordingly, in 1875 he proceeded to Berlin, while retaining association with his Yorkshire factories, Messrs. John W. Leitch and Company with the Colne Vale Dye and Chemical Company; and after returning from Germany, lectured for several years on the chemistry of coal-tar products at the Huddersfield Technical College.

Professor Morgan has laid under deep obligation all those to whom the early history and the early chemistry of artificial dye-manufacture appear momentous and engrossing. The dramatic evocation of lovely colours, beneficent drugs and agreeable perfumes from a disgusting waste-product must appeal to all who can savour the contrasts of life, and can appreciate the importance of the seemingly unimportant. In romance and enlightenment this industry remains unrivalled, while Professor Morgan brings both attributes vividly to mind.

Data on Post-Glacial Climatic Changes in North-West India.

By H. de Terra and G. E. Hutchinson.

IN the course of explorations carried out in the Himalayas, in Indian Tibet and the Punjab foothills, we have come across a number of phenomena which throw some light on post-glacial climatic changes. In view of the growing interest which geologists, meteorologists and archæologists have recently shown in this problem, it seemed desirable to present our observations and to give a brief summary of the multiple evidence of subrecent climatic pulsations.

This evidence may conveniently be classified as follows:—

(1) morainic deposits lying in an intermediate position between terminal moraines of the last Pleistocene glaciation and recent moraines of existing glaciers;
(2) terraces connected with post-glacial movements of valley glaciers;
(3) lake terraces or raised beaches indicating high water levels;
(4) data inferred from ancient chronicles and prehistoric monuments;
(5) indirect data from observations on rock engravings, patination, etc.

1. Recent studies on the Pleistocene glaciation in Kashmir, which were carried out by the first author and Mr. T.T. Paterson, show that valley glaciers advanced five times, leaving distinct traces of moraines and glacio-fluvial outwash deposits in the valleys. Previously already Oestreich, and especially Dainelli, had presented proof for a complete Pleistocene glacial cycle in neighbouring areas, but only through recent work has it become possible to correlate the glacial and interglacial deposits of the mountainous tract with fossiliferous (mainly Upper Siwalik) formations in the adjoining foothills. This correlation permits of dating the second Himalayan ice-advance as being of Boulder Conglomerate or Middle Pleistocene age, so that the following third and fourth glaciations would fall into the Upper Pleistocene. The terminal moraines of the fourth glaciation were observed between 7,500 and 8,500 feet above sea-level, and in most cases the corresponding trough was appreciably smaller than the higher trough scooped out by the third glaciers. This feature already indicates a progressive weakening of the climatic changes so far as their intensity is concerned. Moreover the fifth ice advance was so weak, as compared with the fourth, that hardly any distinct new troughs were made, the glaciers having formed small ice tongues which may have looked like recent glaciers in a somewhat advanced position. That this fifth ice advance was appreciably weaker than the fourth, is clearly seen from the high position of the last terminal moraines which lie 500 to 2,000 feet higher than the moraines of the fourth glaciers. Commonly there is one terminal moraine wall, but in a few valleys there are two sets, the highest and latest of which lies only 500 feet below the recent glacier snout.

These observations make one suspect a post-glacial age for the fifth ice advance in

Kashmir. There are, moreover, other signs indicating a post-Pleistocene origin, namely :

(*a*) the fifth (and sixth) terminal moraines are thinner and smaller than any of the older moraines, and therefore resemble recent glacial deposits ;

(*b*) their rock material reflects the formational composition of a small area restricted to the uppermost parts of the valleys ;

(*c*) their state of preservation is distinctly fresher than that of the lower moraines.

These observations permit the conclusion that the fifth glaciation, as compared with the longer periods of the major ice advances, was of rather short duration.

The question arises whether there occurred one or two post-glacial climatic pessima. In the upper Liddar and in the upper Vishav valleys in Kashmir, Paterson and de Terra observed two sets of younger moraine walls below the present glacier snout. Similar conditions were observed by de Terra in Western Tibet on certain glaciers which descend towards the Sumjiling plain, east of the border pass Lanak La. The older terminal moraine here lay 1,500 ft., the younger one only 600 feet, below the glacier. Considering that these glaciers lie in perfectly graded troughs wherein the ice movement is relatively stable (as compared with glaciers in the Karakorum range), it is very probable that the two moraines represent subrecent stages of glacial retreat.

2. In Kashmir, as also in the adjoining foothill region of Poonch, the post-glacial terminal moraines are frequently associated with at least one, rarely two terraces. This terrace is composed of glacio-fluvial outwash material which was deposited during the waning stage of the valley glaciers. Within the sequence of terraces, found along most of the valleys, this terrace is the fifth and lowest, being often not more than 10 feet above the present stream level. Its gravel is banked up against a prominent slope below the fourth terrace which in itself is connected with a retreat stage of the fourth glaciers. Between the two ice advances evidently lies a long period of erosion, separating the last of the Pleistocene glaciations from the first post-glacial pessimum. Significantly enough, this fifth terrace occurs far outside of the glaciated tract, as in the Potwar and Indus valley regions, where it clearly marks a stage of valley filling, due most likely to increased water supply.

3. Evidence for post-glacial climatic changes as presented by raised beaches have been frequently cited by Hedin and other explorers. In an unpublished paper on the ecology and zoogeography of the fishes of Kashmir and Indian Tibet, the second author reports such phenomena at Lake Pangur in Western Tibet as follows :—

"Around the present shore of Pangur Tso (a few miles beyond Shushul in Ladak) there is a series of four low beaches which, lying in graded steps between 4345 m. and the present lake level at 4329 m., cut into the Pleistocene interglacial lake deposits and into the base of the alluvial fans which cover them. Beaches of this kind are very usual around the closed lakes of Indian Tibet. It is highly probable that all the closed basins experienced a period of high levels in the closing stage of the last glacial, when much water, stored as ice, must have run into their basins. While it appears that the highest post-glacial levels represent a stage at which Pangur was isolated from Panggong Tso, it is quite possible that the latter had for a time an outflow into the Tang-tse Valley at this period. But it is by no means safe to assume that all of the high beaches of post-glacial age were formed at a very remote time. It has been shown (de Terra and Hutchinson, 1934) that considerable oscillations of lake level occurred during the 19th century, a period not especially remarkable for the amplitude of its climatic changes. It is therefore highly probable that at other periods in historic and proto-historic times, oscillations of considerable magnitude have occurred."

This possibility should be kept in mind when interpreting the great number of raised beaches to be found on the shores of Lake Panggong, Mitpal and Tso Moriri in Ladak. At Mitpal Tso we observed some 16 beaches of which a greater portion seemed to be cut into old alluvial fans. Their formation is doubtless due to a progressive lowering of the lake level, but this limpies that during each successive stage the lake remained sufficiently stable for a great number of years to allow wave action to erode the shore. It is also possible that the dwindling reservoirs of snow and ice on the surrounding mountains controlled to a certain degree such changes of lake level, thus exerting a retarding influence on an otherwise more rapid process of desiccation. Future observations should therefore concentrate on a detailed study of post-glacial shore deposits in relation to raised beaches

and to the stratigraphy of deep water sediments.

Outside of the Himalayas, in the Salt Range of the North-West Punjab, are a number of lakes which lie in a region famous for its archæological records. One of these is the Son Sakesar Kahar, in the Shapur district, near the town of Naoshera. On its western end this lake is surrounded by a wide belt of salt marshes, bordered by a terrace which is four feet above the present lake level. On this were found the ruined foundations of an ancient temple-like building whose architecture suggests its having been erected during the first half of the first millennium A.D. This site still showed a number of limestone slabs lying in step-like manner on the terrace edge as if a staircase had led from the main hall to a lake shore. At present this lake shore is dry, the lake being half a mile distant from the edge of the terrace. Although the villagers admitted that the lake submerged occasionally a small portion of the salt marshes, none could recall that the water had ever extended to the ruins, where a much travelled path has led, since ancient times, across the lake basin. It is therefore very probable that at that time the lake extended to the edge of the terrace and in still older periods it must have swept the entire terrace, which is made of lake deposits. This highest level is indicated by various beach remnants found a few miles east of the village of Chitta where wave cut cliffs occur 7 feet above the present lake level of Son Sakesar Kahar. As the area belongs to one of the driest regions in North-West India, it is obvious that this raised beach must represent a period of abundant water supply.

Smaller oscillations of climate leading to the formation of beaches have occurred during the 19th century in Indian Tibet, as de Terra and Hutchinson (*Geogr. J.*, 1934) have shown. The water level of Panggong Tso fell during the first half of the century, till in 1869 it was about 5·9 m. below the level in 1932; subsequent to 1869 a rise took place, the present level probably being established some time after 1900. A very low shore line, about three meters below the lowest level of the sixties of the last century, was observed by Godwin Austen. This clearly indicates an ancient dry period.

4. The Tibetan chronicle *La-dvags-rgyal-rabs* (translation by A. H. Francke, *Archaeol. Survey of India, New Imp. Ser.*, Vol. 50, 1926) mentions from the environs of Lhasa that during the reign of Sron-Khri-lde-btsam (755–797 A. D.) floods and good harvests occurred, which would indicate a wet period, as such always correspond with fertile years in Tibet at present. Quite possibly, this humid phase is the same as the one which is recorded by a raised beach in lake Son Sakesar Kahar in the Salt Range.

Of greater interest however is the chronicle of the kings of Kashmir, *Rajatarangini*. According to A. Stein's translation it describes a vast lake which occupied the Kashmir valley. This lake was drained off by a heroic act of Khashiap who cut the mountain barrier with his magic sword, thus draining the lake towards India. One would think that this saga referred to the "Karewa lake" which existed during the Ice Age and in which the lake beds were deposited, which nowadays form the so-called "Karewas" or raised terraces. This can hardly be the case, for the Karewa lake was drained off at the beginning of the second inter-glacial, as recent studies have proved, and no human tradition is known to date back to the middle of the Ice Age. It is much more probable that the Kashmir saga refers to a great and prolonged inundation of prehistoric and post-glacial times. Such explanation is borne out by the following facts:—

(*a*) Temporary increase of water supply still leads to disastrous floods in Kashmir, and the valley is at such time transformed into chains of lakes which may occupy one-quarter of the entire valley floor. The survey maps 43*J*, 12, 13, 15, 16 amply illustrate how easily the flood plain of the Jhelum river can be inundated by heavy rainfall.

(*b*) The rigidly observed rule that ancient historic sites and prehistoric dwellings are always found on the tops of ancient river terraces or isolated hillocks in Kashmir, would indicate that a lake actually existed in the valley, flooding all outlets of subsidiary streams as well as portions of the central valley floor. A megalithic monument near Srinagar (at Burzahom) is found on the edge of the crest of a 110 foot terrace which is made of Karewa lake clays. Nowadays the terrace projects into swampy rice fields; but it is evident that the Neolithic settlers carefully avoided the low ground, which at

that time may easily have been the litoral swamp of an enlarged Dal lake whose present shore line is only some twenty feet below the level of the rice fields. A second Neolithic site at Nuna, in the Sind valley, presents the same picture, the midden lying some seven feet below the surface of a higher terrace which offered safer ground for settlement than the lower valley floor. As the latter is nowadays fully cultivated and settled, it is evident that at some remote time the Neolithic people avoided the valley floor, most probably for reasons of higher stream levels.

Geologically the megalithic sites in Kashmir bear not only traces of a wet period but of a succeeding dry period as well. Both at Burzahom and at Nuna, but especially at the former place, the megalithic settlements lie buried under seven to twelve feet of pottery-bearing yellow or grey silty soil. This soil is unstratified at Burzahom and so porous that it can only be a windblown deposit. Under present climatic conditions dust storms occur in Kashmir, though not as frequently as in the Punjab. A somewhat greater aridity might be required to produce such loess-like deposits. Some of the Karewa and younger terraces in Kashmir are covered by very similar thin loess-loam, and it would seem that these represent the same dry period which succeeded the megalithic culture. The dating of this period depends of course on the archæological analysis of the pottery found. As the oldest pottery underlies the strata with black burnished ware, which is related to the Chalcolithic ceramics of the lower Indus valley, it would seem as if the megalith culture flourished around 3500 to 4000 B.C. This dating should be considered tentative until the pottery has been analysed by the Archæological Survey of India.

In this connection it is, however, interesting that Sir John Marshall (*Mohenjo Daro and the Indus Valley Civilization*, Vol. I, pp. 2–3, London, 1931) and Sir Aurel Stein gave indisputable evidence of heavier rainfall in Baluchistan during the Chalcolithic civilization of *ca.* 3000 B.C. Of the following period Sir John says, " much of the desiccation of Baluchistan must have taken place at some period between the Chalcolithic Period when the population was comparatively dense and settled, and the fourth century B.C., when Alexander the Great made his disastrous march back through the deserts of Gedrosia, and when its condition must have been as parched and barren as it is to-day."

Whatever the causes for this climatic change may have been, it would seem that a wet period persisted in prehistoric times in North-West India which was followed by extensive desiccation. To the latter period, possibly, belongs the post-megalithic soil in Kashmir.

The submerged condition of certain Hindu temples in Kashmir, as at Manasbal and Pandrethan (see Ram Chandra Khak, *Ancient Monuments of Kashmir*, London, 1933) also is indicative of fluctuating water levels in the valley. The foundations of the Manasval temple lie, nowadays, several feet below the level of the neighbouring lake; and Pandrethan also stands below the ground-water level. It is unlikely that the ancient architects selected marsh or litoral swamps for their sites, but dry ground which demanded drier conditions in the valley. The temples date back to the 11th–12th centuries A.D.

Since the early part of the 17th century no very large changes in water levels seem to have occurred in Kashmir, as the shore position of the mooring ghats of some Moghul gardens has been retained.

5. Indirect data from observations on rock engravings, patinations, etc.

Data from certain Tibetan rock engravings were collected by the second author (*l.c.* unpublished) who states that the patination of rock engravings (stupas, ibex, etc.) near Kargil cannot antedate the introduction of Buddhism to the country (8th century). This slight desert varnish must therefore have developed since the early Middle Ages.

At Tang-tse in Eastern Ladak, engravings on patinated granite boulders have been found, from which Hutchinson draws the following inferences :—(1) since early in the present millennium no patination has formed at Tang-tse, (2) the brown desert varnish on the oldest inscriptions antedates the Nestorian engravings, (3) pictures of a species of deer (*Cervus cf. hanglu*) possibly indicates that at some period in the Middle Ages Indian Tibet was damp enough to support richer vegetation than is found there nowadays.

At no place did we observe ochreous patination on recent soils, from which we

conclude that the desert varnish must have formed at a period which possessed a more arid climate than is prevalent in present-day Indian Tibet.

Rock engravings more ancient than either the Kargil or Tang-tse sites, occur below Attock on the Indus and on erratic blocks lying on the higher terraces near Campbellpore (Punjab). Their age is at present still under consideration but in any event they can tentatively be dated as belonging to a period intermediate between the Neolithic and Chalcolithic. These engravings show slight desert varnish which is thinner than the patination found on the native rock. The latter is of no diagnostic value but the patina on the engravings might well belong to a prehistoric dry stage of the post-glacial loess period.

Hutchinson also draws attention to the changes in the altitude limit of agriculture in Ladak (as reported by Francke *op. cit.*, vol. 1). A distinct lowering of this limit has occurred since the time when the "Mons", a pre-Tibetan tribe of the first millennium A.D., cultivated the higher ground. He says, "Although the possibilities of agriculture in this region are limited largely by water-supply and by presence or absence of suitable sites for fields, it is impossible that the present altitudinal limit is set by these factors, seeing that practically the whole of the water-supply of the modern settlements comes from snow and ice on the mountains and local precipitation is probably of negligible importance in agriculture, while level sites are found, notably, near Phobrang, above 4500 m. It is therefore clear that if the limit of agriculture was formerly higher, conditions for ripening the crop, now often cut when partially green, must have once been more favourale. This, like the supposed but unproved extension of the tree line, would seem to point to a drier, warmer period.

In conclusion, the data discussed above may be tabulated as follows :—

POST-GLACIAL CLIMATIC CHANGES IN N.-W. INDIA.

Wet.	5th terminal moraine in Kashmir, Epi-glacial.
—	Assumed dry interval, so far unrecorded.
Wet.	6th terminal moraine in Kashmir, Epi-glacial.
? *Dry.*	Possibly dry pre-Neolithic patination of Indus boulder at Attock and Campbellpore ?
Wet. ca. 4000-2500 B.C.	Megalithic settlements in Kashmir. Rainfall in excess of present precipitation in Baluchistan and Upper Sind.
Dry. ? 2000-300 B.C.	Post-megalithic loessic soil in Kashmir. Desiccation in Baluchistan and North-West India antedating Alexander's campaign. Pre-Tibetan Mon period, upward extension of agriclture in the first millennium A.D.
? *Wet.* 8th century A.D.	Period of floods in Central Tibet.
Dry. 11th-12th century A.D.	Submerged Hindu temples in Kashmir.
? *Wet.* Middle Ages.	In Western Tibet (Tang-tse) drawing of stag.
Wet. 18th century	High lake levels on Lake Manasarovar in Tibet.
-early 19th century.	High lake levels in Western Tibet.
Dry. Middle of 19th century.	Low lake levels in Western Tibet.
Wet. Early 20th century.	Almost all lakes rising in Western Tibet.

SUGGESTIONS FOR FURTHER STUDIES.

The above discussion shows how meager our present knowledge on post-glacial climatic changes in N.-W. India is ; and we suggest for study, therefore, a number of subjects which, in our opinion, would yield more complete information.

(1) Dendrochronological studies on ancient Deodar trees in the Himalayas and on every kind of wood found in ancient graves. (For instance on pine wood, reported by A. H. Francke from pre-Tibetan Mon graves at Gya in Ladak.)

(2) Studies on lake sedimentation with special reference to the occurrence of brackish or salt water diatoms, such as have already been reported by Lundquist from the Kashmir lakes. Efficient borings through lake sediments would give interesting results as to alternation of $CaCO_3$ and ferrous sulphide rich gyttja deposits.

(3) Additional pollen analysis of Pleistocene and subrecent sediments such as we

began in the last years (see *Memoirs Connecticut Ac. of Sciences*, New Haven, Conn.)

(4) History of village communities in Western Tibet in relation to agriculture, and position of prehistoric sites in relation to drainage pattern.

(5) Analysis of water in closed lakes and estimates of rate of flow into such lakes.

The Karewas of Kashmir.*

By Birbal Sahni, SC.D., F.G.S., F.R.S.,
Professor of Botany, University of Lucknow.

THE well-known fact that the fossil remains of sea animals are found on the crest of the Himalayas frequently conveys to the lay mind a picture of mountain tops submerged in an ocean which rose above those heights. Similarly, lake deposits containing the relics of aquatic plants and animals, if found on the elevated slopes of a mountain, might easily convince the uninitiated that a lake must have once existed at that high level.

That this popular fallacy should have invaded the mind of even a modern scientist is the excuse for the present article.

A few days ago my attention was drawn to a report under the heading "*Prehistoric lake near Gulmarg: abundance of fossil plants*" recently published in the *Civil and Military Gazette* of Lahore.[1] Dr. R. R. Stewart of Rawalpindi, an American missionary and botanist, is reported to have expressed the view that there appears to have been "a lake some thousands of years ago at a height of 11,000 feet, just above Gulmarg".

This opinion is evidently based upon the fact, well known to Indian geologists, that lake deposits containing fossil remains, including modern species of aquatic plants and animals, occur on the slopes of the Pir Panjal Range, at altitudes where these species cannot exist to-day.

This brief article will attempt to explain to the general reader the significance of these high-level deposits, known to geologists as the Karewa Series. The Kashmiri name Karewa is applied to the more or less flat terraces or table-lands which cover a great part of the Valley, specially on the left bank of the Jhelum. In places these terraces are found sloping gradually up the mountains on either side of the valley; excellent examples are to be seen from the road between Srinagar and Gulmarg, on the two sides of the Ferozepur Nala, specially below Tangmarg. Recently they have even been traced up in a continuous series as far as the crest of the Pir Panjal Range, which bounds the Kashmir valley on the south-west.

For the information of those not familiar with Kashmir we may say that Gulmarg is a favourite summer resort at about 8,800 ft. altitude on the densely wooded NE slopes of the Pir Panjal Range. These slopes are thickly covered with the old moraines of glaciers which several times during the Pleistocene Ice Age, overran the greater part of Kashmir. Where the moraines are not covered with forest they form extensive undulating meadows, in the Kashmiri language called *marys*, as at Gulmarg, Khilanmarg, Sonemarg, etc. The Pir Panjal Range runs in a NW-SE direction, roughly parallel to the main Himalayan chain which lies east of it. The celebrated Vale of Kashmir, about 84 miles long and 25 miles in its broadest part, lies protected between these snowclad ranges, at a height of about 5,200 to 5,500 feet above sea-level. The river Jhelum issues from springs near the higher SE end of the valley and meanders peacefully through fertile plains to the NW end which is a few hundred feet lower. Here it escapes in rapids through a gorge near Baramula, only ten miles north of Gulmarg in a direct line. See map, Fig. 1.[2]

Ordinarily a casual newspaper report on a scientific matter does not deserve serious notice. But Dr. Stewart has been commissioned by an important scientific body—the Yale North India Expedition (popularly known here as the Karakoram Expedition)–to identify and describe the fossil plants from some of these lake deposits on the slopes of the Pir Panjal. And the conclusion he has arrived at directly conflicts with one of the main scientific results of the Expedition and, in fact, with long established geological evidence.[3]

The fossil-bearing sediments near Gulmarg, like many other deposits of clay, sand and

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* Except for the introductory reference to the press report, this article embodies the substance of an extension lecture delivered at the Punjab University, Lahore, on March 26, 1936.

[1] May 21, 1936, page 5.

[2] This map also illustrates another article in the present volume of *Current Science*, shortly to be published under the title. "*The Himalayan Uplift since the Advent of Man*".

[3] See *e.g.*, Wadia, *Geology of India*, 1926 (Macmillan), pp. 263–264, 383.

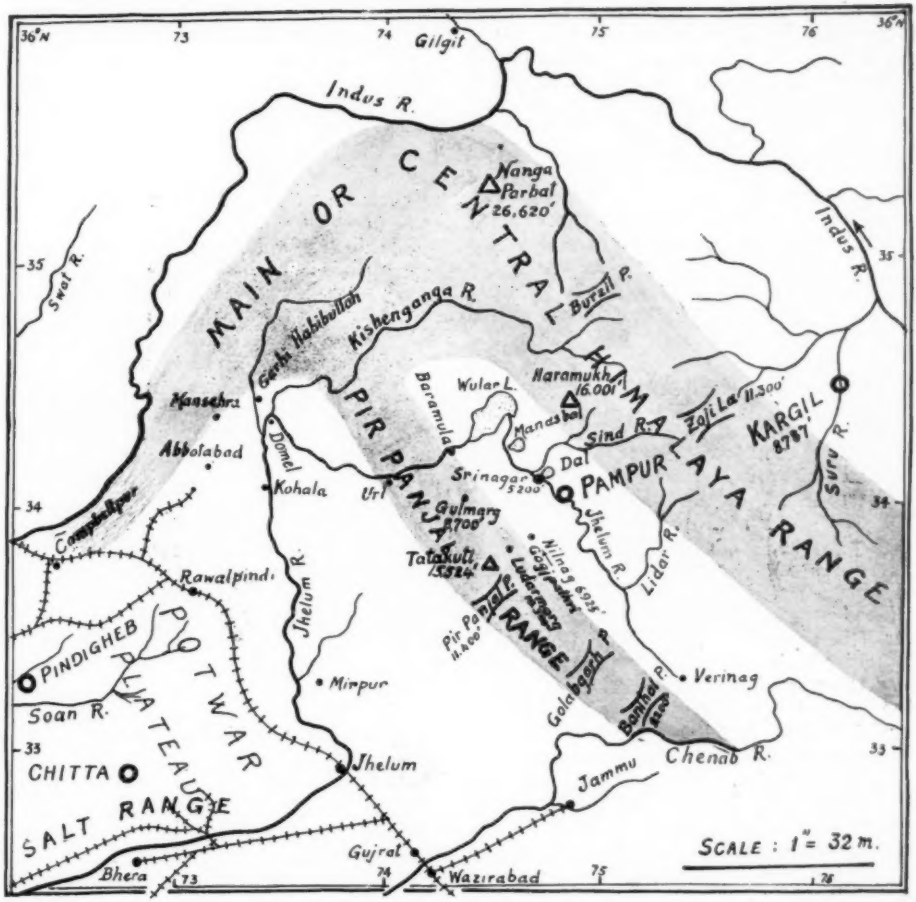

Fig. 1.

gravel on the NE slopes of the Pir Panjal, were no doubt laid down, as Dr. Stewart suggests, in the bed of a lake. *But that lake never existed at the high altitude where its bed is now seen.* Strange though it may seem, this lake must have been situated several thousand feet lower, at the same level as the main valley of Kashmir. Since the time when the plants and animals, of which the fossil remains are now found at 11,000 ft. or even higher, flourished in and around this lake, the sediments have been *lifted out of their original horizontal position* and have been *upheaved through at least five thousand feet with the (geologically speaking) recent upheaval of the Pir Panjal Range.*

The story of these fossil plants from the Pir Panjal Range is briefly as follows. As long ago as 1864, Godwin Austen[4] drew attention to the occurrence of fossil leaves belonging to modern species of plants in clay deposits at Gojipatri (Gogjipatri) near Nilnag, and at Ludarmarg, a meadow about three marches south-east of Gulmarg. Since then fossil plants have been discovered in similar deposits at numerous localities in the Pir Panjal by Middlemiss,[5] Wadia and others.[6] In 1932, Dr. Hellmut de Terra, the

[4] *Quart. Journ. Geol. Soc.*, XX, 383.

[5] *Rec. Geol. Surv. Ind.*, XLI, 120-121, 125 (1911).

[6] Wadia, *loc. cit.*; Sahni, Presid. Addr. to Bot. Sec., Ind. Sci. Congress, Calcutta, *Proc. As. Soc. Beng. (N.S.)*, XVII (1921), clxix-clxx; Wodehouse, "The Pleistocene Pollen of Kashmir," *Mem. Conn. Acad.*, IX, Art. I (1935), 3-18, with Introd. Note by H. de Terra, 1-2. Hawkes, Hawkes and de Terra, Yale North India Expedition: Palæolithic Human Industries in N.W.

leader of the Karakoram Expedition, made a large collection which was presented to the University of Lucknow and entrusted for description to the late Dr. S. K. Mukerji. With his extensive knowledge of the modern flora of Kashmir and, especially, his thorough appreciation of the geological aspects of the problem, Dr. Mukerji was exceptionally well fitted for this investigation. But his premature death in 1934 deprived the expedition of a valued collaborator.[7] Subsequently the entire collection, as well as the notes and preliminary identifications left by him, were on Dr. de Terra's request forwarded to Dr. Stewart, who is now continuing the work of my late colleague.

But before his death, Dr. Mukerji had already arrived at some important results, recently announced by Dr. de Terra[8]. Among the numerous types recognised by Mukerji there were not only land plants (chiefly forest trees and shrubs, such as species of oak, willow, poplar, alder, barberry, rose, rhododendron, cinnamon, holly and box), but also several types of aquatic vegetation, notably the waternut or *singhára* (*Trapa*), *Vallisneria* and stoneworts (*Charophyta*). These aquatic plants still flourish in the Dal, Manasbal and Wular lakes, or in the stagnant backwaters of the Jhelum, far away down in the Valley, several thousand feet lower than the heights at which their fossil remains are now found in the Pir Panjal. So far as we know, they do not exist in any of the numerous lakes, tarns and streams on the higher slopes of the mountains, where the water is either too rushy, or frozen for too long a period in the year. The land plants are rather a mixed lot, mostly represented by species now living on the lower slopes, up to about 9,000 feet; a few, like the rose, have a wide range in altitude, while others grow near the upper limit of tree vegetation.

Let us for the moment confine our attention to the aquatic species which, as stated, live only in the lakes and sluggish streams of the valley. How can we explain the presence of their fossil remains at altitudes where we know they cannot exist to-day? Has the climate of these altitudes become colder since these plants lived; or have these species of plants become acclimatised to the warmer waters of the valley? To the layman, at any rate, these would seem to be the only obvious explanations. But, as we shall see presently, both these views are based upon the unwarranted assumption that the lake (or lakes) existed at the altitudes where their deposits are now seen resting, covered with snow for the greater part of the year.

This is the real point at issue. And its importance will be at once realised when I say that it provides the main proof for the view that a great part of the Pir Panjal Range has been uplifted in quite recent geological times: in fact, as we shall see, since the advent of Man in Kashmir.

The idea that the Pir Panjal Range is largely of recent origin is not new. It was suggested long ago by Godwin Austen in unmistakable terms. Twenty-five years ago Middlemiss[9] advanced further evidence in support of it, while Wadia[10] and several other Indian geologists have repeatedly sponsored this view. The Italian explorers Dainelli[11] and de Filippi[12] also arrived at a similar conclusion. And quite recently de Terra and his co-workers have provided further and more convincing evidence in the same direction.[13] As a slight digression we may add that this recent elevation of the Pir Panjal Range is only a small part of a vast upheaval which has affected the main Himalayan range on the one side and the Potwar plateau (between Rawalpindi and Jhelum) on the other, during the period while Man existed in this part of the world.[14] I propose to deal in a later article with the relation of these recent earth movements to the early history of our own species. Here my main concern is to show that the lacustrine beds near Gulmarg, like a dozen other outcrops in which I have collected fossils in the Gulmarg-Baramula region, were deposited in a low-level lake, where the climate was milder.

Punjab and Kashmir, *Mem. Conn. Acad.*, VIII, esp. Introd. and Geological Commentary by de Terra, i–iv, 11–15.

[7] See Obit. Notice in this journal, 1934.

[8] See Wodehouse, *loc. cit.*, Introd. Note by de Terra (1935).

[9] *Loc cit.*

[10] *Loc. cit.* 264, 383.

[11] Studi sul glaciale: Spedizione italiana de Filippi nell' Himalaia, ser. 2, III (1922).

[12] Himalaya, Karakoram and Eastern Turkestan (1932).

[13] See de Terra, Prelim. Report, Yale North India Expedition, *Science*, LXXVII, No. 2004, 497–500 (1933); *Ibid.*, Himalayan and Alpine Orogenies, XVI. International Geolog. Congress, Washington, 1933, p. 9 and literature cited (1934); Hawkes, Hawkes and de Terra, *loc. cit.*; Wodehouse, *loc. cit.*

[14] See Wadia, *Mem. Geol. Surv. Ind.*, LI (2), 334 (1928); *Quart. Journ. Geol. Min. Met. Soc. Ind.*, IV (3), 69–96 (1932) and literature cited.

Similar strata, now tilted at angles as high as 30° to 40°, have long been known to occur in the Pir Panjal, sometimes at altitudes even higher than 13,000 feet above the level of the sea; and it is significant that, except for local variations due to other causes, their slope (geologically known as the "dip") is always towards the Valley. What is more, the same deposits have been traced downwards continuously, with gradually decreasing dip, into the valley, where they are seen mostly in their undisturbed horizontal or almost horizontal position (Fig. 2). At one time the valley of Kashmir must have been covered from end to end by these Karewa deposits, which at least 1,000 feet in thickness, which disclose the chequered history of Kashmir during the ages since primitive man first made his appearance here. Below these "Upper Karewas," which contain abundant plant and animal remains of Pleistocene age, as well as Palæolithic stone implements,[15] there is an even greater thickness of older or "Lower Karewas," dating back into Pliocene times. But with these we are not concerned here.

The nature of a stratum, whether fine clay, sand or gravel; its relation with the underlying or overlying strata; and its fossil contents, if any, indicate whether it was deposited in deep water or near a shore, in

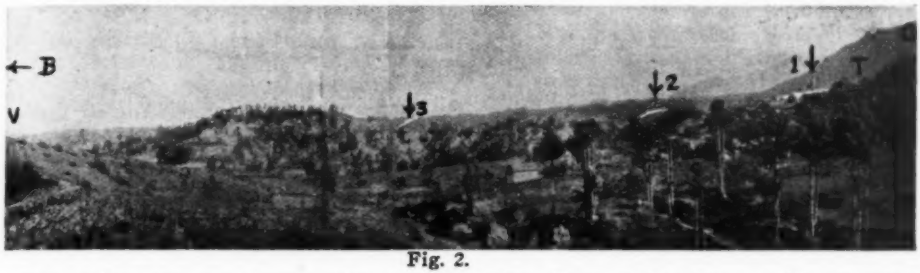

Fig. 2.

View looking east from Naugam ridge towards Dodbug (Surv. of Ind. Map 43 J/8). B points to Baramula; V Karewa deposits in Valley (about 5,500 ft. alt.); T Tangmarg (7,000 ft.); G lies below Gulmarg (8,800 ft.). The white bands 1, 2, 3 are Karewa beds exposed in cliff sections. Note the gradual rise of ground from V to T, about 1,500 ft. in 6 miles. *P(B. S. koto,* 4-7-1934)

either represent the sediments of a single vast body of water or, perhaps more probably, of a series of connected lakes. The existence of Karewa deposits almost as far as the crest of the Panjal Range shows beyond doubt that this lake must have greatly exceeded the present width of the Kashmir valley; and, although at present there is no such evidence, it is by no means unlikely that in places they may be discovered actually overtopping the range and extending to the south-western (that is, the Punjab) slopes of these mountains.

Rain and rivers have cut up the once continuous expanse of Karewas in the Valley into strips and isolated blocks in the form of flat-topped hills. But these remnants still cover nearly half the area of the Valley, and form a conspicuous feature of the landscape. The Karewa at Pampur, celebrated for its saffron fields, is a picturesque example.

Where the vertical thickness of the Karewa Series of deposits is exposed, for example in ravines and gorges, it reveals an imposing succession of strata, totalling stagnant water or in a stream that fed the lake. Its careful study goes a long way to establish conclusions regarding the climatic conditions and the character of the flora and fauna existing at the time of deposition. We know, for example, that in places the Karewa beds rest upon an ancient rock-bottom which shows unmistakable signs of having once been scratched and polished by glaciers, dragging over the old surface their tremendous weight of ice and its contained rock-débris or "moraine". Elsewhere we find fossiliferous clays, containing evidences of life in a temperate climate, such as the shells or skeletons of modern freshwater animals, or the leaves of familiar forest trees, *interbedded with deposits of undoubted glacial origin, indicating arctic conditions.*

Explorers in Kashmir have found that here, as in Europe during the Ice Age, there were several periods of extreme cold when

[15] Hawkes, Hawkes and de Terra, *loc. cit.*, 7, pl. II, fig. 3.

glaciers overran even the lower valleys, alternating with relatively warm periods when the ice retreated to the higher regions and allowed the growth of a temperate flora and fauna. And one of the main tasks of the expedition led by Dr. de Terra was to correlate, if possible, the glacial and interglacial periods of northern India with those of Europe. Important conclusions regarding the way in which the plants and animals in this region responded to the changing physical conditions may also be expected from a detailed investigation of the floras and faunas preserved in the different strata of the Karewa Series.

Under the meadowed moraines of Gulmarg itself, which provide such excellent golf links, fossiliferous interglacial clays are exposed at several places in the banks of the meandering brooks. Some of them are almost black with decayed plant-remains; others, of a blue grey colour, are crowded with the shells of fresh-water mollusca, chiefly gasteropods. They remind one of times when this area lay at a considerably lower level and was covered by a lake teeming with animal life. Then came a cold wave, and glaciers from Toshmaidan and from the heights we now know as the Apharwat descended upon the lake, loaded with débris torn from the rocks in their downward path. With the final melting away of the ice the confused mass of sand, clay and angular boulders of various sizes was left behind in mounds, more or less as we find them to-day (Fig. 3). It will interest the reader to know that of the several kinds of fossil shells which I collected from an interglacial bed near the hotel (Fig. 4) at Gulmarg,[16] at least one species is also found in the recent alluvium of the river Gomti at Lucknow, where the summer temperatures are all but intolerable.

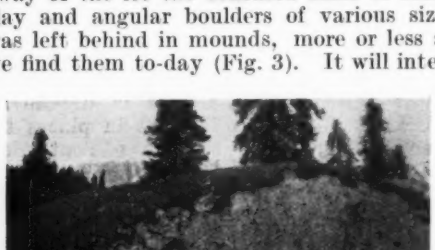

Fig. 3.
Section of re-sorted Moraine at Gulmarg; Apharwat in the background. (*B. S.*)

Fig. 4.
Fossiliferous Interglacial Karewa bed (K) underlying a moraine (M). The topmost layer is Loess Gulmarg, 8,750 ft. (*B. S. Photo, July* 1934)

The Ferozepur Nala just above Tangmarg has cut through a large terminal moraine which must have once almost filled the gorge above the village of Māhiyan. Remnants of this moraine must also be present on the right bank of the stream below Drang. The pony track to Gulmarg traverses the moraine at about 7,500 feet above sea-level, where Mr. Wadia has shown me many good examples of ice-worn boulders. Higher up, the moraine is overlain by lake deposits indicating a return to a warmer climate.

Holiday makers in Kashmir might usefully spend some hours in searching for Palæolithic implements in the "Upper Karewas" of the valley. In the Pampur Karewa near Srinagar, Dr. de Terra recently found several pieces of stone, at least one of which was regarded by experts as "*unmistakably....a humanly-worked flake-implement.*" This important discovery, which no doubt will be followed up by further investigation, tends to show, as Godwin Austen had acutely suggested long ago, that the Himalayan uplift had not yet been completed when man first made his appearance on the globe.[17]

Among the most interesting of the Pleistocene deposits of Kashmir are certain extremely thin layers of alternating fine and coarse clay which were deposited in lakes formed by the damming up of valleys by the terminal moraines of glaciers. They are sometimes so thin that they remind one of

[16] I am indebted to my friend Dr. Baini Pershad of Calcutta for kindly identifying these shells for me.

[17] Hawkes, Hawkes and de Terra, *loc. cit.*, pp. 7, 11, 14; pl. II, fig. 3.

the leaves of a book. These so-called "laminated" clays, technically known as "varves", are very characteristic of glaciated countries. The coarser layers are formed of the heavier sediments brought down by glacier streams during the summer when the ice melts more rapidly; the finer layers represent the winters, when the thin streams fail to carry any but the finest paricles. Each varve, with its summer and winter zones, thus usually indicates a period of one year—unless, of course, in a particular year the seasons have been abnormal, as sometimes happens now-a-days. It is thus possible, by counting up the varves in a given thickness of strata, to calculate with a fair degree of accuracy the total period represented by that deposit in solar years. Such calculations have been used with great advantage by geologists in determining the number of years that have passed since a particular area was glaciated. Thus, for example, the Swedish geologist Baron de Geer has been led to suggest that Stockholm became free from the Ice only about ten thousand years ago.

Apart from the seasonal variation shown by the zones within each varve, Swedish workers led by Prof. de Geer have discovered that long climatic cycles during the geologically recent past are recorded in the varying thickness of the annual varves as a whole. During the warm (interglacial) cycles, when the glaciers were in retreat or were confined only to the higher valleys, each varve often reached the thickness of an inch or more. During the glacial intervals they might not be more than a fraction of a millimetre thick. Taking the relative thickness of the varves as a measure of the heat radiated by the sun, Prof. de Geer and his pupils have been able to correlate the glacial and interglacial periods of Sweden with those of North America; and a similar attempt has been made recently by Dr. E. Norin[18] in Northern Kashmir. Only the preliminary results of Dr. Norin's work have so far been published, and it would be rash to accept them at once as final. But if these promising results should prove to be substantiated by fuller evidence they would go a long way to show that in spite of the long distance between the two countries the glacial and interglacial periods in the Himalayas corresponded with those in the Swedish time scale. This they may well be expected to have done all over the world if they were only due to periodic variations in the amount of solar heat received by the earth.

During excursions in July 1934 I discovered near the hamlet of Hajabal, a few miles north of Gulmarg, a narrow ravine in which a great thickness of light and dark brown varves is beautifully exposed in a cliff section. Similar varves, though much folded by subsequent pressure (perhaps due to the advance of a glacier against them) are well seen at Bota Pathri about five miles WNW of Gulmarg. The counting and measuring of these and other varves in the Karewa Series should lead to important conclusions concerning the history of the Ice Age in Kashmir. The organic remains in the associated fossil-bearing strata, as well as fossils collected in several other localities in this neighbourhood, for example, Tsunt Pathri, Nambil Nar, Dandamuh, Satar Siran, to name only a few, are now being investigated by Dr. S. C. Varma of Lucknow.

There is a well-known tradition in Kashmir, which goes back to time immemorial, that the whole of the Valley was formerly occupied by a lake. This is one of those many traditions relating to the physical features of our country which have been found to fit in with the observed facts of Science. The Dal, the Manasbal, the Wular and many other modern lakes in the Valley of Kashmir are but the shrinking remnants of this great Pleistocene lake on whose shores Palæolithic Man plied his stony trade. Writing as I am from the heights of Gulmarg itself, with the Happy Valley mapped out, as it were, before my feet, I can picture this ancient lake, inhabited by a flora and fauna not very different from that which flourishes to-day in the Manasbal or Wular; and surrounded by wooded hills of no great height except towards the north and east, where lay the main range of the Himalayas. To quote Dr. de Terra himself, "This ancient body of fresh water, known as the Karewa Lake, once filled at least 2,000 square miles of the Kashmir valley. On the north it was flanked by the slope of the main Himalaya and on the south by *a low ridge, now represented by the high Pir Panjal Range, which*

[18] Norin (1925), Preliminary notes on the late Quaternary glaciation of the NW Himalaya. Data 2, Fr. Stockholms Högskolas Geokronol. Inst., *Geografiska Annaler*, H. 3; Norin (1927), Late glacial clay varves in Himalaya connected with the Swedish time scale. Data 11, *Ibid.*, H. 3.

separated the lake basin from the Indian plains."[19]

The prehistoric lake of which Dr. Stewart speaks may well have been part of the Karewa Lake, and the plants and animals now found as fossils at high altitudes lived in that lake or on the wooded slopes bounding its western shores. The leaves and twigs, fruits and seeds of the forest trees were carried down by streams and became mixed up with the remains of the low level aquatic vegetation buried in the silt of the lake. Apart from these larger fragments of plants, which can be recognised by the unaided eye, the pollen of many species of trees and herbs was also carried down by the water, or was blown down and became sealed up in the clay. Owing to the fact that, like the cuticles of plants, the outer coat of these microscopic pollen grains is very resistant to the natural agents of decay, and because the pollen of many plants is very characteristic, it has been possible for Dr. Wodehouse to recognise several kinds of plants from their pollen grains alone, both in the Karewa deposits and in the silt that is being laid down to-day in the beds of the modern lakes of Kashmir.

Before closing this brief account of the Karewas mention must be made of a wide-spread deposit of fine yellow or brown sandy earth, known as Loess. In places it forms a mantle several feet thick over the Karewas: it is distinguished by a tendency to form steep slopes or cliffs which are marked by rather charcteristic sinuous rills. The Loess is a deposit of modern times, regarded in origin as wind-borne dust blown over from the plains. Good exposures are to be seen on the golf links at Gulmarg. The Loess has its own importance in the study of human history, but the subject is beyond our present scope.

This is, briefly, the romantic story of the Karewas of Kashmir. Their study leads to the irresistible, though at first incredible, conclusion that the Himalayas have been thrown up by several thousand feet since the advent of man. We may well repeat, in the words of our inspiring teacher of geology, the late Professor T. McKenny Hughes: "Don't be afraid of earth movements, don't be afraid of earth movements"!

GULMARG (Kashmir),
June 13, 1936.

[19] Introd. Note to Wodehouse (1935), *loc. cit.*, p. 1. The italics are mine. See also De Terra (1936), Late Cenozoic history in India, *Nature*, **137**, 686-688.

"Indian Science Abstracts".

THE National Institute of Sciences of India, Calcutta, resolved to issue a publication under the title '*Indian Science Abstracts*' with the sub-title '*Being an Annotated Bibliography of Science in India*' every year. The first part of this publication has just been issued, but the General Editor, realising the impossibility of making such a publication complete without the active co-operation of all scientific workers in the country, requests them kindly to look through the 1st Part and see whether all their scientific publications issued during 1935 have been included in it. A great deal of matter for the 2nd Part is already in type, and if all the workers will kindly help by sending abstracts of such of their papers as have not been included in Part I, this will ensure making the record complete for all the scientific publications issued during 1935. *En passant* it may be noted that the publication is intended to include abstracts of all scientific papers published in India, as also of papers published abroad on work done in India or based on Indian material.

The arrangement of abstracts in Part I of the "*Abstracts*" is purely tentative, and any suggestions for making the publication more useful will be gratefully received, and an attempt made to embody, as far as possible, such suggestions in the succeeding parts.

Instructions for the prepartion of abstracts can be obtained from the offices of the National Institute of Sciences of India, 1, Park Street, Calcutta.

Obituary.

WE have to record our profound sense of sorrow at the premature death of Principal Dr. Krishna Kumar Mathur, Principal of the Science College, Benares Hindu University, on July 18th at Lucknow. Dr. K. K. Mathur was one of the foremost geologists of India, who had won the esteem and affection of all his fellow-workers, and had served the Benares Hindu University in various capacities with faithful devotion.

LETTERS TO THE EDITOR.

CONTENTS.

On the Geiger-Nuttal Relation.

IT is well known that the velocity of the particles emitted by radioactive substances is determined from an experimental measurement of the range and the empirical relation of Geiger-Nuttal, connecting the range with the velocity. An attempt to deduce a similar formula on theoretical grounds, was made by Bohr as early as 1913. Recently, Gaunt[1] and Bethe[2] have deduced the corresponding wavemechanical formulæ. In these theories the classical dynamics is freely used at a later stage, to arrive at a formula somewhat analogous to that of Bohr. Moreover, Bethe's formula involves a function which is computed with difficulty.[3]

According to the wavestatistical theory, which is just developed and is being published elsewhere, the general relation connecting the range (R) with the velocity (v) is of the form

$$R = \ldots + a_2 v^2 + a_3 v^3 + a_4 v^4 + a_5 v^5 + \ldots$$

where $a_2, a_3, \ldots$, etc., are constant coefficients. It may be remarked that v^3- and v^4-terms are found to be important, the other terms coming only as approximations. Thus Geiger's v^3- and v^4-rule for low and high velocity, is supported by the wavestatistical theory.

K. C. KAR.

Presidency College,
Calcutta,
June, 1936.

[1] *Proc. Camb. Phil. Soc.*, 1925-27, **23**, 732.
[2] *Ann. der Phys.*, 1930, **5**, 325.
[3] *Vide* Blackett, *Proc. Roy. Soc.*, 1932, **135**, 132,

Constitution of Formic Acid and the Formates.

IN a letter to the Editor Mr. Halasyam[1] suggests that the values used by me for the calculation of the parachor of formic acid[2] were an arbitrary selection of the values of Sugden and of Mumford and Phillips. Actually as indicated[3] in foot-note 4 the calculated value (93·2 units) which I gave is the standard value given in Landolt-Bornstein,[4] the atomic and structural constants used in that calculation being those which are generally regarded as the best. The differentiation between hydrogen attached to oxygen and hydrogen attached to carbon adopted in Landolt-Bornstein is an improvement on the original values of Sugden, which is justified in that it enables satisfactory values of the parachor to be calculated not only for formic acid, but also for a wide range of hydroxy-compounds.[5]

Mr. Halasyam in his original calculation of the parachor of the Sarkar-Ray formula for formic acid[6] used Mumford and Phillips' values. In his recent letter[7] he quotes for the classical formula the value of 102·2 using Sugden's unrevised values which are now out of date, and which also give incorrect values for other acids, for which there is no question of an alternative formula. As indicated in my previous letter, the best modern calculated value for the parachor of the classical formula agrees closely with the experimental value. Mr. Halasyam has nowhere quoted for comparison a Mumford-Phillips value for the

parachor of the classical formula. These authors[8] calculate on their system the parachor of acetic acid to be 130·6. Deducting their value for CH_2 (40·0), the value for the classical formula for formic acid comes out to be 90·6 which is sufficiently close to the observed value of 93·6.

It is clear therefore, and in this Dr. Seshadri agrees with me[9] that parachor values cannot be used to distinguish between the Sarkar-Ray and the classical formula for formic acid.

With regard to the abnormal chemical activity of formic acid, Mr. Heble, in this laboratory, has recently observed that formic acid reacts with acetyl and benzoyl chlorides to give the corresponding acid, HCl and CO. It also reacts on heating with benzyl chloride, benzal chloride, and benzotrichloride with evolution of HCl and CO; on these reactions a method of estimating side-chain halogen has been based.

T. S. WHEELER.

Royal Institute of Science,
Bombay,
June 15, 1936.

1 *Curr. Sci.*, 1936, **4**, 812.
2 *Curr. Sci.*, 1936, **4**, 650.
3 *Loc. cit.*
4 *2nd Supplement*, 5th Edition, 1931, pp. 172, 173, 175, 177.
5 *Cf.* Bhatnagar and Singh, *J. Chim. Phys.*, 1928, **25**, 21.
6 *J. Indian Chem. Soc.*, 1935, **12**, 813.
7 *Loc. cit.*
8 *J.C.S.*, 1929, 2128.
9 *Curr. Sci.*, 1936, **4**, 813.

Decolourising Action of Fuller's Earth.

THE decolourising action of fuller's earth and its activation by acids have not yet been satisfactorily explained on chemical or physical basis. Earlier attempts deal with either the chemical constituents of the earth,[1,2] or with the usual absorption theories.[3] Recently Thurman[4] attempted to show the relationship between the pH of the earths and their decolourising action. But according to him, addition of acid or alkali decreased the decolourising power of a Florida earth. Fogle and Ohn[5] attributed the clarifying action of the fuller's earth to its zeolite content, but account has not been taken by these authors of an important characteristic property of these earths, of liberating acid on being shaken with a salt solution.[6] In the course of our work on the activation of fuller's earths obtained from different parts of India, for decolourising vegetable oils, we found that the pH of a solution of sodium chloride after treatment with earths varied in the same manner as the change in the Lovibond units of colour of a sample of groundnut oil treated with the earths. The bleaching values were determined by agitating a sample of neutral groundnut oil with 2 per cent. of the earth at 90°–95° C. and matching the colour with a Lovibond tintometer. For activation, the earths were treated with hydrochloric acid of 19–20 Be′ (added as 20 grams of dry HCl per 100 grams of the earth) under reflux for three hours, and washed.[7] For

TABLE I.

No.	Source	Original		Treated with acid and washed			
				Heated to 110° C.		Heated to 400° C.	
		Change Lovibond Units	pH	Change Lovibond Units	pH	Change Lovibond Units	pH
		y		*y*		*y*	
1	Florida	3·3	3·74	3·1	3·24	3·1	4·02
2	Kolhapur	1·4	7·22	2·9	3·76	2·0	4·95
3	Jodhpur	2·4	7·82	2·9	3·47	3·2	3·91
4	Bhawanagar	1·1	8·81	3·0	4·10	3·2	4·70
5	Murwara, C.P.	1·4	7·48	1·3	4·71	2·1	6·36
6	Germany	3·2	3·50	3·3	3·45	3·3	3·60

pH measurements 50 c.c. of one per cent. solution of sodium chloride was shaken with 0·5 gram of the earths. The table given above gives some of the results which are graphically shown in Fig. 1.

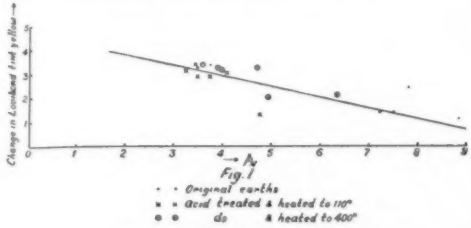

Fig. 1.

The accuracy of the colour measurements as compared with the accuracy of the pH measurements by the quinhydrone electrode is limited by the use of the Lovibond Tintometer and accounts for the discrepancies. Our results, however, indiciate that the decolourising action and the activation by acids of these earths are directly related with the exchangeable hydrogen contained in the earth. While thus indirectly supporting the conclusion of Fogle and Ohn regarding the zeolitic nature of the active ingredient in the fuller's earth, our results show that it is not "calcium" zeolite but "hydrogen" zeolite that is active in decolourising. It is possible that the action of the zeolite is replaced by the hydrogen ion during the process of activation by acids, the hydrogen in turn being replaced by the sodium ion when treated with the salt solution, both reactions being governed by the law of mass action. The "hydrolytic adsorption," by other clays can be explained on the same basis. Further work is in progress.

B. S. KULKARNI.
S. K. K. JATKAR.

Department of General Chemistry,
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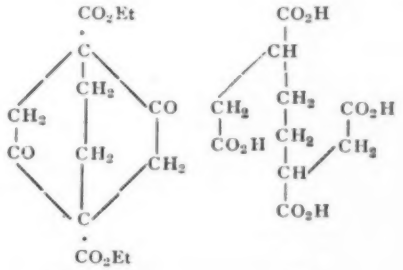
Bangalore,
June 29, 1936.

p-Bridging of Succinosuccinic Ester.

CONSIDERING the products obtainable from succinosuccinic ester by bridging the *p*-carbon atoms with methylene iodide or ethylene bromide "to be of extremely great interest," Baeyer[1] tried the experiments evidently without success. The non-formation of a strainless tricyclic system from bi*cyclo*-nonanedionetetracarboxylic ester, alike Baeyer's failure, were attributed by Meerwein[2] to the splitting up of the bridged compounds by alkali.

After a large number of attempts made under varying experimental conditions, the desired bridge formation has now been effected by boiling dry sodio-derivative of succinosuccinic ester under reflux during 72 hours with ethylene and trimethylene bromides, the resulting compounds melting at 112° and 132° respectively. That the reactions have not taken place in the enolic phase, is proved by the fact that the bridged compounds give sharp melting disemicarbazones. The bridged esters are easily hydrolysed to the corresponding diacids, m.p. 274° and 238° respectively by boiling with dilute HCl (1 : 1) and these acids, in turn, give sharp melting disemicarbazones. It is interesting to note that the bridged esters cannot be decarboxylated under conditions in which succinosuccinic ester readily gives 1 : 4-diketohexamethylene. The compound, m.p. 112° (I) on treatment with 10 per cent. alcoholic potash suffers ring fission to yield, what appears from combustion analysis and equivalent determination to be $\beta\beta'$-dicarboxy-suberic acid, m.p. 170° (II) as yet unknown and on treatment with 1·5 per cent.



neutral permanganate it gives an acid, m.p. 150° which, however, seems to be

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[1] Welds, *Z. Angew. Chem.*, 1927, **40**, 7982.
[2] Haseman, *J. Phys. Chem.*, 1929, **33**, 1514.
[3] Neuman, *Z. Angew. Chem.*, 1927, **40**, 337.
[4] Thurman, *Ind. Eng. Chem.*, 1932, **24**, 1189.
[5] Fogle and Ohn, *Ind. Eng. Chem.*, 1933, **25**, 1070.
[6] Bancroft, *Applied Colloid Chemistry*, 3rd Ed., p. 146, McGraw-Hill, 1932.
Also *Cf.* Chameron, *J. Phys. Chem.*, 1910, **14**, 400.
[7] Burgharat, *Ind. Eng. Chem.*, 1931, **23**, 801.

different from adipic acid. Further work is being continued.

P. C. GUHA.
Department of Organic Chemistry,
Indian Institute of Science,
Bangalore, India,
April 25, 1936.

[1] Baeyer, *Ber.*, 1892, **25**, 2123.
[2] Meerwein, *J. Pr. Chem.*, 1922, (ii), **104**, 180.

A Synthesis of *Cis*- and *Trans-dl*-1-*iso*-Propyl *Cyclo*propane-1 : 2-Dicarboxylic Acids and a Resolution of the *Cis* Acid. Synthesis of Umbellularic Acid.

IN his experiments on the constitution of umbellulone, Tutin[1] obtained as the ultimate product of its oxidation, an optically active dibasic acid, umbellularic acid, $C_8H_{12}O_4$, m.p. 120–121° $(\alpha)_D - 89{\cdot}7°$ (in $CHCl_3$). Although Tutin believed the acid to be a derivative of methyl *cyclo*-pentane, the experiments of Semmler[2] definitely fixed its constitution as 1-*iso*propyl *cyclo*propane-1 : 2-dicarboxylic acid. The *cis*- and *trans-dl*-forms of this acid have now been synthesised.* Also the *cis* acid has been resolved into its optical antipodes and the properties of the latter are identical with those of umbellularic acid.[1]

Ethyl α-*iso*propyl acrylate[3] adds on ethyl diazoacetate to give ethyl 5-*iso*propyl-Δ^1 pyrazoline-3 : 5-dicarboxylate, b.p. 158° at 1 mm. and the latter splits off nitrogen at 200°[4] giving rise to the mixed ester, b.p. 144-48°/28 mm. On hydrolysis this furnishes *trans-dl*-1-*iso*propyl *cyclo*propane-1 : 2-dicarboxylic acid (m.p. 195°·0 C.)† in about 35% yield, the rest being a liquid mixture of unsaturated acids. The *cis* anhydride prepared from *trans* acid by heating with acetylchloride at 180°, boils at about 140°/20 mm. The *cis-dl*-acid crystallises from water with one molecule of the solvent (m.p. 95°, sintering 86°). The anhydrous acid melts at 124–125° and passes over to the anhydride at 150°. The chemical properties of these two acids are identical with those of umbellularic acid.[1]

On combining *cis-dl*-acid with brucine in aqueous solution the salt of the *d*-form separated first, and had the composition $C_{54}H_{64}O_{12}N_4 \cdot 9H_2O$ $(\alpha)_D^{30°} - 25{\cdot}63$ (in alcohol). The active acid liberated from the salt had $(\alpha)_D^{31°} + 87{\cdot}7$ (in $CHCl_3$), m.p. 118° with $1H_2O$ about 83°. For obtaining the *l*-acid cinchonidine was employed, when the salt of the *l* form $C_{27}H_{34}N_2O_5$, separated first. The acid liberated had $(\alpha)_D^{31°} - 81°{\cdot}13$. The crystalline forms of both the antipodes were in agreement with those cited by Tutin for umbellularic acid.

Full details of the work have been sent for publication elsewhere.

S. K. RANGANATHAN.
Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
June 11, 1936.

[1] Tutin, *J.C.S.*, 1906, **89**, 1104.
[2] Semmler, *Ber.*, 1907, **40**, 5019; *Ibid.*, 1908, **41**, 3988.
[3] Blaise and Luttringer, *Bull. Soc. Chim.*, 1905, (3), **33**, 648, 776.
[4] Buchner and Papendieck, *Annalen*, 1893, **273**, 232. von Auwers and König, *Ibid.*, 1932, **496**, 252.

* The Synthesis of the *dl*-acids was complete and the resolution of the *cis* acid was in hand when an abstract on the synthesis of umbellularic acid appeared (Rydon, *Chem. and Ind.*, 1936, **55**, 294). The method adopted by Rydon, however, is different and we thought it fit to continue our work and place the results for publication.

† The figures for melting point given in this note are all uncorrected.

Apparatus for the Measurement of Respiratory Exchange in Plants.

FOR the measurement of respiratory gaseous exchange in plants Haldane's gas-analysis apparatus is commonly employed. Although highly accurate, the apparatus in its original form[1] is inconvenient and rather cumbersome for respiration studies in plants. Carpenter[2] has replaced the long, cylindrical levelling tube which is rather difficult to manipulate, by a small mercury bulb which is easily handled. The original Haldane apparatus contains a combustion pipette for the oxidation of carbon monoxide or methane. This pipette was utilised to advantage by Carpenter[2] for the absorption of oxygen by means of moist phosphorus. It has the advantage over potassium pyrogallate that it does not have to be renewed so frequently and that the absorption can be carried out without the continuous raising and lowering of the mercury levelling bulb. In this Laboratory, however, during the course of investigations on the gas-storage of tropical fruits the apparatus has been further simplified and the technique for the measurement of respiratory exchange in plants considerably improved. The gas sampler employed by Haldane has been dispensed with, the measuring pipette serving as a sampling appliance as well. The potassium pyrogallate bulb (together with its accessory bulbs) has been replaced by a phosphorus bulb of the type employed by Carpenter,[2]

thus minimising the breakages which frequently occur in this apparatus. For the simultaneous determination of the CO_2 evolved and the oxygen absorbed, the plant organs are enclosed in air-tight chambers which provide for the removal of test portions for analysis. The use of respiration chambers with rubber stoppers is open to criticism, as rubber has a tendency to absorb CO_2 and also to let it diffuse through it. To circumvent this difficulty, two new types of respiration chambers have been constructed into which the various gas mixtures are easily introduced and which are trustworthy in regard to their air-tightness. A method, similar in principle to the Münzer-Neumann method[3] for the calibration of Warburg and Barcroft manometers, is suggested for the calibration of the respiration chambers after the introduction of the plant material.

The measuring pipette P of the apparatus (Fig. 1) can be put in communication either with the KOH bulb C or the phosphorus bulb D by means of the Friedrich-Greiner tap F. The phosphorus bulb is similar in construction to the combustion pipette employed by Haldane except that the ignition tubes inside it have been removed and a water levelling bulb added. The bulb is filled with stick yellow phosphorus of suitable length so that 21 c.c. of gas can be introduced into it. The measuring pipette P and the compensation pipette P' are enclosed within a glass jacket, the water in which is kept stirred by means of an air-blower B. The manipulation, in brief, is as follows. The air in the apparatus is first freed from CO_2 and oxygen in order that all of the capillaries may be filled with nitrogen. Subsequent to this, the 3-way stopcocks G and H and the tap F are turned

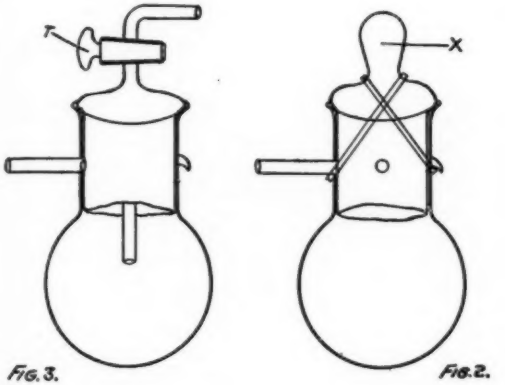

FIG. 3. FIG. 2.

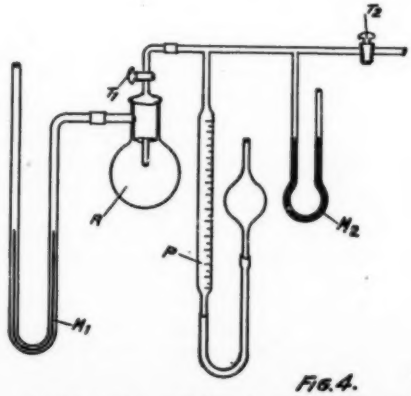

FIG. 4.

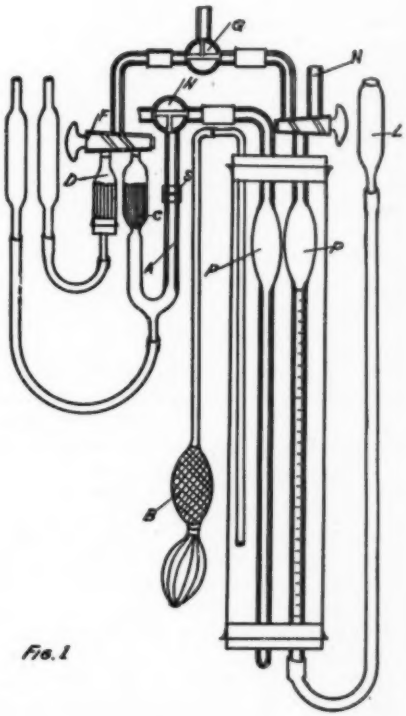

FIG. 1

An Adaptation of Haldane's Apparatus for the Measurement of Plant Respiration.

in the positions shown in Fig. 1, and the KOH levels on the potash bulb C and the side tube A are set. The sliding mark S on the tube A can be moved up or down as the case may be. After this the taps G and H are turned so that the apparatus no longer communicates with the atmosphere at these points. Sampling is done (by the washing method) by interposing a 3-way stopcock between the tube N and the respiration chamber, the gas samples being drawn in and sent out of the measuring pipette by means of the levelling bulb L. As a rule, 2–3 washings give satisfactory results invariably. Further details of procedure have already been described by Carpenter.[2]

When it is required to measure only the respiratory quotient (*e.g.*, in following the chemistry of respiration) the respiration chamber (capacity 500–600 c.c.) depicted in Fig. 2 is employed. In carrying out an experiment, a single fruit is put into the respiration chamber and the required gas mixture introduced by the evacuation method.[4] The chamber is subsequently closed by turning the ground-glass stopper X, which is kept in position by two strong rubber bands stretched across it (Fig. 2). The respiration chamber shown in Fig. 3 is used when it is intended to know the absolute amounts of CO_2 evolved and oxygen absorbed in addition to the respiratory quotient. For this purpose it is necessary to determine the total volume of the gas mixture as well as the percentages of its different constituents.[5] The gas analysis yields the percentage content of the various components whereas the volume of the gas space in the respiration chamber is determined by employing the Münzer-Neumann method.[3] The arrangement is represented diagrammatically in Fig. 4. The respiration chamber is represented at R, P is a graduated 5 c.c. pipette, and M_1 and M_2 are two manometers containing paraffin. After levelling the manometer M_2 and closing the tap T_2, the mercury in P is lowered so as to withdraw some gas from the respiration chamber. After this the tap T_1 is closed, and the manometer M_2 is adjusted exactly to level once more. The difference in the readings of the manometer M_1 gives the decrease in pressure in the respiration chamber and that in the readings of the pipette P gives the volume of gas withdrawn at the atmospheric pressure. Applying the Boyle-Mariotte law, the desired total volume of gas in the respiration chamber is easily computed.[5]

B. N. SINGH.
P. B. MATHUR.

Benares Hindu University,
India,
May 20, 1936.

[1] Haldane, *Methods of Air Analysis* (London), 1912.
[2] Carpenter, *Carnegie Inst. Wash., Pub.* No. 216, 1915, p. 70.
[3] Münzer and Neumann, *Biochem. Z.*, 1917, **81**, 319.
[4] Keilin, *Proc. Roy. Soc., Lond.*, 1929, **104B**, 206.
[5] Kostychev's *Plant Respiration* (Eng. trans. by Lyon), 1927, Philadelphia.

Observations on the Dark, Opaque Inclusions in the Nellore Garnets.

THE garnet which encloses the inclusion being almost transparent in thin sections, these inclusions which are black and opaque, are clearly visible in transmitted light. Micrometric estimates show that they form about two per cent. of the garnet by volume. They have submetallic to adamantine lustre; streak is black; colour iron-black with a slight violet tint. Most of these inclusions are granular but some of them are minute tabular crystals, often in thin plates or laminæ. These inclusions are magnetic and they are magnetically more powerful than almandite (garnet) but slightly less than ilmenite. Under the microscope in transmitted light, these inclusions are opaque except for a few enclosed rutile crystals. In reflected light they exhibit a steel-grey colour tinged with pale violet. While some of them show clear crystal boundaries when examined "*in situ*," many present a streaky and granular appearance.

To separate these inclusions from the garnet the following procedure was adopted: A few crystals of garnet were reduced to a 100 mesh powder which was then treated with an electromagnet when a concentrate of this black mineral was obtained. The impurities and lighter minerals like quartz which accompanied the concentrate were removed by using a heavy liquid (methylene iodide). A pure sample was then obtained by repeatedly treating the concentrates with a horse-shoe magnet to the poles of which two needles were attached to bring about a pointed field. A final picking under a microscope was also resorted to.

When strongly heated, these inclusions change to a brownish black colour and an increase in weight is also noticed. When

fused with Na_2CO_3 the material is only slowly decomposed, but fusion with either potassium bisulphate or sodium bisulphate results in complete decomposition of the material and the fused mass thus obtained dissolves readily and almost completely in hot dilute H_2SO_4. These inclusions give no tests for either calcium or manganese, but no attempt was made to test for the presence of alkalies. A very pure sample of these inclusions obtained as indicated above was analysed and the results obtained are as follows :

ANALYSIS OF INCLUSIONS.

Oxides.	Per cent.
TiO_2	65·85
FeO (by difference)	18·84
Fe_2O_3	15·31
SiO_2	trace
Total ..	100·00

A complete analysis of the entire garnet showed a titanium content of nearly 1·0 per cent. Since careful tests with clear garnet grains as well as with the quartz inclusions found therein, showed complete absence of titanium, it appears certain that all the titanium associated with the garnet is present in these black inclusions.

A microscopic study indicated that crystals of rutile are sometimes present in the inclusions to the extent of 7 to 8 per cent. This small quantity of rutile cannot account for the high percentage of TiO_2 found by chemical analysis. The chemical analysis shows also that the TiO_2 content is far in excess of the ferrous oxide required to form normal ilmenite, and that there is in addition a large proportion of ferric oxide. Further work is in progress with a view to explain the large TiO_2 content of these inclusions.

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Department of General Chemistry,
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Bangalore,
June 11, 1936.

A Preliminary Note on the Development of Embryo-sac in *Averrhoa carambola* Linn.

THE earlier work on the development of the embryo-sac in Oxalidaceæ is limited to a few species of *Oxalis* worked out by Hofmeister (1858), Johnson (1881), Billings (1901), Hammond (1908) and Schürhoff (1926) as cited by the latter author[1] in his book, besides work on other phases of its embryology. Hence it has been thought worthwhile to examine first an arborescent representative, *Averrhoa carambola*. The writer, however, hopes to complete the work on other Indian representatives of the family and the material has already been accumulated.

During the early stages of the ovule, the nucellar cells at its tip stain like archesporial cells, although only one of them grows further to form the megaspore mother-cell. The single archesporial cell undergoes a periclinal division and cuts off a parietal cell. The latter again divides further to form a not extensive parietal tissue above the embryo-sac. The megaspore mother-cell undergoes the usual heterotypic and the homotypic divisions resulting usually in a linear tetrad and occasionally in a T-shaped one. Both the types of tetrads have, however, been seen in the same ovary. The chalazal megaspore is the functional one and develops in the normal manner into an 8-nucleate embryo-sac, after three successive free nuclear divisions. In the young embryo-sac the antipodal cells are organised first. They degenerate early before fertilisation. The synergids then differentiate out and become hooked. The polar nuclei start from their respective poles, meet about the middle of the embryo-sac, move upwards and take their position near the egg-apparatus. The embryo-sac undergoes an increase in size on all sides. It crushes the parietal tissue above and the nucellus on the sides and ultimately becomes situated just below the nucellar epidermis except at its chalazal part. Thus the embryo-sac follows a normal course of development and becomes 4-nucleate just before fertilisation due to the early degeneration of the antipodals. These observations accord with those of the earlier investigations.

Full details of the embryology of this species will be published elsewhere in due course.

In the end the writer takes great pleasure in expressing his sincere thanks to Mr. I. Banerji for valuable guidance during the progress of the work and also wishes to express his deep indebtedness to Prof. S. P. Agharker, M.A., PH.D., for affording facilities in the Botanical Laboratory, University College of Science, Calcutta, where the investigation has been carried out.

Cocanada, V. VENKATESWARLU.
June 4, 1936.

[1] Schurhoff, P. N., *Die Zytologie der bluten-pflanzen*, Stuttgart, 1926.

On the Existence of Two Different Types of Striped Eyes among Solitary Type Specimens of the Desert Locust *Schistocerca gregaria* Forsk.

IT was discovered in 1932 at the Locust Research Laboratory, Lyallpur, that there is a striking difference in the colouration of the compound eyes of the adults and hoppers of the two phases, *solitaria* and *gregaria*, of the Desert Locust. While in the *phasis gregaria* the eyes are uniformly claret coloured, those of the *solitaria* show a number of chocolate-coloured stripes alternating with cream-coloured interstripes.

The writer has worked out the histological basis of this difference and its probable physiological significance in the vision of the locust. Briefly, the findings were that whereas in the unstriped or "gregarious" eye, both the primary (distal) and secondary (proximal) pigment cells of an ommatidium are pigmented, in the striped or "solitary" eye such a condition obtains only in the ommatidia lying beneath the stripes. In the ommatidia lying beneath the interstripes the secondary pigment cells alone are pigmented. Other smaller differences also occur.*

An examination of a large number of specimens of the Desert Locust found in the breeding ground of Mekran (Baluchistan) and showing the solitary colouration, has shown that, while in the majority of cases the compound eyes have six stripes (and seven interstripes), in others seven clear stripes (and eight interstripes) are present. Thus any considerable collection of solitary locusts can be divided into two types, *viz.*,

Type I—with 6-striped eyes (Fig. 1).

Type II—with 7-striped eyes (Fig. 2).

In both the types, the second interstripe (IS^2) from the posterior side, is always broader than the rest and forms, so to speak, a landmark in the eye. It is found that whereas there is always a single stripe behind this interstripe, the number of stripes anterior to it may either be five or six, thus giving rise to the two types of eyes mentioned above.

An analysis of 727 locusts have shown (Table I) that the type with the 6-striped eyes is more common, forming 79·3% of the locusts examined. Since the number of stripes in the large number of specimens examined was invariably either six or seven the two types cannot be regarded as a case of simple variation. The origin of this difference is, however, obscure. Whether the difference is inherited in a genetic way, can be shown only by extensive breeding experiments.

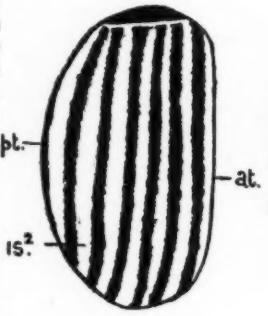

Fig. 1.

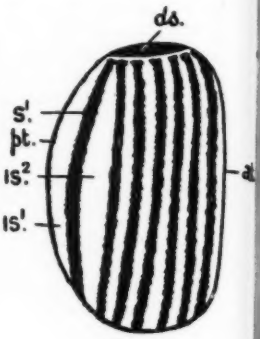

Fig. 2.

Fig. 1.—Side-view of the left eye of a female of *Schistocerca gregaria*, phase *solitaria*, showing 6 eye-stripes. × about 10. *at.*, anterior margin of eye; IS^2, second interstripe from the posterior side; *pt.*, posterior margin of eye.

Fig. 2.—Side-view of the left eye of a female of *Schistocerca gregaria*, phase *solitaria*, showing 7 eye-stripes. × about 10. *at.*, anterior margin of eye; *ds.*, dorsal spot of eye; IS^1, first interstripe from the posterior side; IS^2, second interstripe from the posterior side; *pt.*, posterior margin of eye; S^1, first stripe from the posterior side.

TABLE I.

Types of striped eyes	Sex	No. of specimens	Total No. in each type	Percentage in each type
Type I—with 6 stripes	♂	348	578	79·3
	♀	230		
Type II—with 7 stripes	♂	62	149	21·7
	♀	87		

It is proposed to make further observations in the course of the year as to the significance of this difference.

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Locust Research Field Laboratory,
Pasni, Baluchistan,
June 6, 1936.

* This investigation, as yet unpublished, was carried out during 1932-33 at the Locust Research Laboratory, Lyallpur, under the general direction of Mr. M. Afzal Hussain.

SUPPLEMENT TO "CURRENT SCIENCE".

Vol. V] July 1936 [No. 1

The First Jena Catalogue of Optical Glasses Published in 1886.

By

Prof. Dr. Moritz von Rohr

THE chromatic aberrations met with in modern optical instruments and their correction are best and most fruitfully discussed by looking back to the work of the early pioneers.

We may mention that Newton's genius began investigating the coloured band of the primary spectrum, and his subdivision of it into the 7 parts (the *partial dispersions* in our language) of red, orange, yellow, green, blue, indigo and violet was accepted for more than 100 years.

Whereas Newton thought it impossible to devise refracting instruments free from colour aberration, it was in the years between 1729 and 1733, that a gifted amateur, Chester Moor Hall, actually planned an achromatic object glass (composed of a positive crown and a negative flint lens) for a telescope and had it successfully made by London opticians. But the time was not yet ripe for his great invention and the optical world had still to wait a quarter of a century till 1758, when J. Dollond brought on the market his famous achromatic telescopes.

They were certainly generally appreciated, but in 1762 A.C. Clairaut, a French scientist, was able to show that in Dollond's achromatic glasses not every trace of colour had been destroyed and that the reason for this was to be found in the fact that the partial dispersions from red to violet were *not proportionate* in the crown and in the flint glass.

No numerical valuation of this want of proportionality could be given at that time, as the boundary lines between the 7 coloured parts were much too indistinct. Every improvement in the colour correction during the latter half of the 18th century was therefore restricted to trial and error.

In this latter half of the 18th century two scientists must be mentioned in this respect: Father R. J. Boscovich S.J., a professor at the Paduan University, who published his very important views on this subject about the year 1765, and R. Blair

of Edinburgh, a ship's surgeon, who tried about the year 1791 to construct a telescope objective showing remarkably diminished chromatic aberrations, or, in our modern language, an insignificant *secondary spectrum* only.

Both these investigators had to recur for their experiments to fluid media, *i.e.*, pure water or solutions of different acids in water. In consequence of this drawback—fluid lenses not producing sharp images, owing to the striæ caused by differences of temperature—the work of these scientists, although of great theoretical importance, failed to improve the state of practical optics at that time.

The generally accepted necessity of employing solid optical substances only—different kinds of optical glass and natural crystals like pebble—sooner or later compelled practical opticians to direct their attention to the possibility of melting *optical glass*. Two different kinds were necessary, as Chester Moor Hall already knew: for positive lenses: crown glass with *low* refraction and *low* dispersion, and for negative lenses: flint glass with *high* refraction and *high* dispersion.

Whereas the supply of flint glass as furnished by the ordinary technical glass factories was neither sufficient nor perfect, so that the output of good telescopes especially of somewhat larger diameter was endangered, P. L. Guinand, a Swiss amateur glass founder, began to develop methods for melting *optical glass* apart from the ordinary *technical* rules; after many trials, he made in 1798 his first improved experiments in *stirring* the liquid contents of the crucible. By a very remarkable combination of circumstances he was, in 1805, engaged by the owner of a small Bavarian optical factory, so that he had to direct his energy to founding ordinary crown and ordinary flint glass for the manufacture of telescopes. Soon after he made J. Fraunhofer's acquaintance, who, towards the end of 1807, was the young foreman of this optical factory.

There is not room enough for entering here at some length into the interesting history of this famous optical factory and it must suffice to say that between August 1809 and December 1813 Guinand-Fraunhofer's important process for melting optical glass in sheets of considerable size was developed and put to the test.

Being sure of the technical solution of this problem Fraunhofer set to work—as it seems since the first days in 1814—to find the exact data necessary for introducing the optical qualities of any melting into his scientific calculations. In our modern way of expression we may say that in time he accomplished the task of exactly measuring the *refractive index* of every melting as well as its *dispersion*.

This, as a matter of fact, was the very aim striven after but missed by all scientific opticians from R. J. Boscovich's time downwards. After a not unsuccessful attempt with an instrument we should designate to-day as a *monochromator*, Fraunhofer hit upon the idea of using the dark lines of the solar spectrum so to say as unchangeable landmarks within the coloured band. We do not know the exact time of this application falling in between the beginning of 1814 and April 1817; its description formed a part of his important paper read before the Munich Academy in the spring of 1817. Seven of these dark lines had been described as early as 1802 by W. H. Wollaston, but this scientist made his observations by the naked eye and thought of using them simply as boundary marks between the regions of different colour.

Fraunhofer, with his splendid gift for observing and measuring, examined these lines by means of a theodolite of considerable magnification and was therefore, in 1817, able to publish an exact chart of the solar spectrum and to account for 574 dark lines, the most important of which he traced on

the chart. Later on he was able to determine the length of the corresponding light waves for seven of his most important lines; and for more than 40 years these data remained the most exact values known.

But to return to the chromatic aberration: by means of the dark lines he could now exactly measure the partial dispersions and accurately verify Clairaut's supposition of 1762. In his important paper of 1817 he further demonstrated that for different pairs of optical media (fluids enclosed) the degree of this unwished for disproportionality was quite different. He concluded, there was the hope of founding pairs of optical glass types (fit to be used as crown and as flint) with a more or less proportionate increase of the partial dispersions. We shall, in the following, designate such a pair of optical glasses as answering to Fraunhofer's *postulate* for colour correction.

In his paper of 1817 he could describe such a pair as a remarkable approximation to the ideal solution. His two sample meltings were designated as Flint 13 and Crown M. He, however, refrained from introducing them at large, probably because the durability of these combinations was not sufficiently proved.

In order to show graphically the improvement brought about by Fraunhofer with regard to the better proportionality of the partial dispersions we shall apply a well-known method. As the length of the *complete* primary spectrum (say, from the red line B to the violet line G) caused by a prism of sufficiently small refractive angle is proportionate to this angle, we are—by judiciously choosing each of the refractive angles—able to prescribe a certain standard length (say, of 250 mm. or about 10 inches) for the complete primary spectrum of any glass melting. A certain pair of glasses being chosen to serve as the crown and as the flint lens of an achromatic telescope objective, we are therefore able to give the same standard length to each of the complete spectra.

In consequence of Clairaut's law the *partial* dispersions of crown and flint are then by no means equal, and the lengths, say, from B to C, from C to D, etc., will differ the more for both glasses, the greater the disproportionality existing in them. We shall see this at a glance, if we arrange the two spectra of standard length with their subdivisions so that the crown spectrum is above the flint spectrum.

The two drawings of Fig. 1 show very clearly a marked want of proportionality in a pair formed by ordinary crown and ordinary flint and the advantage gained by

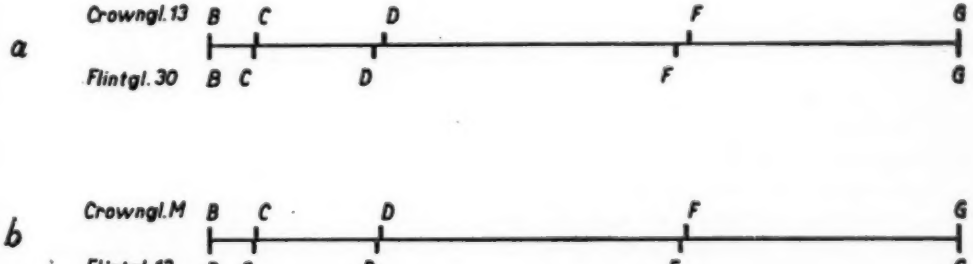

Fig. 1.

Representing the disproportionality of the partial dispersions in crown and flint.

a: Ordinary crown and flint according to FRAUNHOFER'S measurements.

b: FRAUNHOFER'S improved crown and flint according to FRAUNHOFER'S measurements.

Fraunhofer in this respect by the new pair formed of crown M and flint 13.

Fraunhofer did not desist from these experiments and in December 1823 he mentioned the fact of having achieved marked improvements in his sample meltings. But the data were then not given.

His premature death, on the 7th June of 1826, put an end to this really scientific management of the Bavarian optical factory. From numerous appreciations of his work—by English and French scientists also—we can to-day only infer his incomparable mastery respecting the optical problems of his time.

With reference to the diminution of the secondary spectrum the most remarkable instance of practical work between the efforts of Fraunhofer and those at Jena must be ascribed to the collaboration of M. V. V. Harcourt and G. G. Stokes from 1862 to 1871. In 1874 we even hear of a telescope objective with small secondary spectrum; in connection with this experiment the English glass works of Chance Bros. made, in 1874–75, an experiment with the Titano-silicic crown (on the suggestion of Prof. Stokes) on a large scale in the hope of having it employed for telescopes with reduced secondary colours. Although the result did not come up to expectations it must be noted here as the *first large melting of new glass* made with the object of placing practical opticians in a position to achieve sensibly better correction of their instruments.

The new impulse to colour correction given at Jena from 1871 onwards was independent of Fraunhofer's work as it resulted from scientific endeavours undertaken for the improvement not of the *telescope* but of the *microscope* objective. The new ideas were formed by E. Abbe, a young mathematician, who in 1870 successfully undertook the arduous task of following the rays from the object point through the microscope objective by means of trigonometrical calculation. He soon found the principal obstacle to a good correction to lie in certain chromatic aberrations completely different from the disproportionality of the partial dispersions in crown and flint, or, in other words, *different from the secondary spectrum*. Although in the total of chromatic aberration this effect due to the secondary spectrum was also present, it formed only an insignificant part compared with the other error, called by Abbe the *chromatic difference of spherical aberration*.

He soon directed his whole attention to this predominant part of the chromatic aberration. In order to form an estimate of the improvement given to the image by its annihilation or correction, he introduced into his trial systems some fluid media as lenses. They were, of course, enclosed by two glass lenses serving as a front and as a back shell. His trials of 1873 and 1876 showed an image vastly improved after removal of the chromatic difference of spherical aberration. Such fluid lenses were necessitated by his plan in so far as it was feasible to reserve one of the two inner or contact surfaces of the fluid lenses to combat the chromatic difference of spherical aberration alone. When reviewing his own work in 1893, he emphasised the theoretical progress achieved with these early trial systems containing fluid lenses in so far as the aim and the direction of Schott's great achievement in founding new glass types was already fixed by these purely theoretical experiments. Needless to say that these two systems with fluid lenses were never destined to be sold as ordinary microscope objectives; they were planned only for the instruction of both leading men, Abbe and Zeiss, by allowing them a glimpse of the microscope objective of the future.

He contributed an article to the two volumes of critical observations on the *Loan-Collection* of 1876 published by Hofmann in 1878, and he showed the real reason for the state of microscope optics as revealed

with the help of this instructive collection, by pointing to the far too restricted choice of glass types accessible to the practical optician. So he formulated *his new condition* for the correction of the chromatic difference of spherical aberration: new optical glasses are necessary, combining either low refraction with rather high dispersion, or high refraction with rather low dispersion. Abbe's *new condition* may also be expressed in the following manner: a glass of a certain dispersion being necessary, a freer choice for the refractive index should be open than with the old series of silicate glasses, where higher dispersion was always coupled with higher refraction and *vice versa*.

For a graphic representation of Abbe's theoretical postulate we shall insert a graph published in 1899 for showing up the advantage offered by the then new Jena glasses. In correspondence with Abbe's ideas, every melting in Fig. 2 is represented by a point

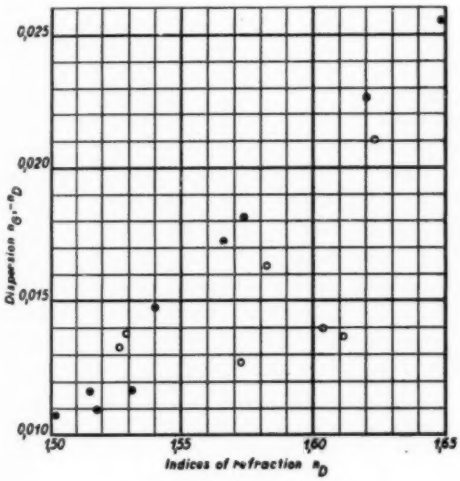

Fig. 2.

Graph illustrating ABBE'S postulate and its fulfilment by the new Jena glasses.

whose abscissa gives the mean refractive index n_D' and the ordinate indicates the dispersion $n_G' - n_D$. (This special value was chosen, because in the book of 1899 the photographic objective had been treated.)

The series of old glasses (represented by dots) forms roughly a straight line; therefore, the dispersion being prescribed, the computing optician has no choice for the mean refractive index or *vice versa*. It is different with the new Jena glasses of 1886 and later (represented by circlets). Here a certain *area* is covered; in other words, a certain value of the dispersion (*e.g.*, 0·014) being given, the choice for the mean refraction is still open over a considerable interval (*e.g.*, $1{\cdot}53 < n_D < 1{\cdot}605$).

Abbe thought it possible in 1878 that scientific bodies in the different countries might successfully instigate their optical factories for working in this direction.

The actual development of the new ideas took, however, a different course: Abbe's article in Hofmann's collective volumes was itself the means of bringing him and O. Schott together. A new era in the making of optical glass was forming itself, as a mathematician knowing (as we said before) the direction and the aim of the intended progress was brought into contact with an energetic and highly inventive founder of glass. English readers may suitably remember the consequences of the joint work of Harcourt and Stokes on Fraunhofer's postulate. On two different occasions G. G. Stokes himself insisted on the importance of influences due to one partner on the other and *vice versa*.

With the successful Jena Glass-Works the case was similar; its great success cannot be ascribed to one of the two partners predominantly: it was a combined achievement due to their coalition.

As early as January 1881 they began to work unitedly, having always before their eyes the production of new glass types more or less similar in effect to the fluid media. Early in 1882 O. Schott took up his abode

in Jena and in March of the same year they prepared a report of the new hopes and expectations based on their extensive laboratory work in founding, measuring and discussing nearly a hundred different sample meltings. This report was virtually written for the Prussian Government, as a body willing to raise the mechanical arts in Germany to a higher level. It was very favourable for this plan that one of the higher officials concerned, W. Wehrenpfennig, was much impressed by Abbe's personality. State help was actually forthcoming (in two instalments of 25,000 and of 35,000 Marks equal to a total of about £3,000 at that time), so that the four leading men in Jena, Abbe, Schott, father Zeiss and his son, were able to erect a glass-works especially for new glass types. Needless to say that both postulates, the old one by Fraunhofer and the new one by Abbe, were considered; but it stands to reason that the principal endeavours at that time were directed towards the new postulate as a decided success in this direction was of vital importance for the microscope factory. Very soon, in the autumn of 1883 ,the first specimen of an *apochromatic* objective was ready, in other words a microscope objective *spherically corrected for two colours* and *free from secondary spectrum*. The correction of these two principal aberrations gave to the new form the advantage of a much sharper image able to bear a far greater magnification by the eye-piece. Other objectives were in the course of preparation and were tested in the next year.

The year 1885 was reserved by the new glass foundry for coming into touch with the practical opticians of the country and in July 1886 the concern was able to publish its first *Scientific Catalogue of Optical Meltings*. Many of them were new types and at the same time Abbe's new scheme for the scientific description of each melting was put into practice.

Nearly at the same date the complete series of the new apochromatic objectives was published; it proved what a judicious selection of new optical media could effect in combination with an equally well-directed calculation work.

Although Fraunhofer's first steps had been taken in the same direction more than 70 years before—and the work of Stokes and Harcourt may also range in this line—for the eighties the idea was quite new and in the retrospect even startling that in Jena the foundry and the optical works were—in a scientific sense—not independent of each other, but that the foundry acted on the hints given by the scientists conducting the extensive calculations.

So, later on, the heavy baryta crown glasses were markedly improved as the planning of the Jena anastigmatic allowed to infer their great economic future. A similarly wide appreciation was in store for the specially limpid boro-silicate-crown that was to be used extensively for the prism glasses from 1893 onwards. And in conclusion we may refer to the nearly ideal achievement of Fraunhofer's condition of higher achromatism, when the pair of glasses at first introduced as telescope crown and telescope flint was made available.

REVIEWS.

The Future of Marriage in Western Civilisation. By Edward Westermarck. (Macmillan & Co., London.) 1936. Pp. xiv + 281. Price 12*s.* 6*d.* net.

This work is a dispassionate and scholarly presentation of a subject, whose inherent interest holds a strong appeal not only to the social anthropologist but also to the general reader. The investigations of the author have led him to conclude that the family instinct is far too deep rooted in human nature to be eradicated, whatever vicissitudes might overtake the economic life of man, and therefore marriage as a social institution is bound to survive as a permanent feature of sex relationship. At the same time he has pointed out that divorce will become comparatively easier and that even sexual acts outside the conjugal limits would likely lose the moral censure and penal legislation, under which they are now laid. The author maintains that his conclusions are not based on the general tendencies of to-day, but that they have been reached from the assumed continuance of those feelings which trace the origin of marriage and family life, and the ingrained taste for variety in sex experience. It is true that when conjugal and parental sentiments should disappear as the result of reaction due to the increase of knowledge and stern economic necessities, then marriage and the family system also must vanish. The assumptions of the author possess a considerable degree of certainty so far as the near future is considered, and to that extent the main thesis of the book is indisputable.

The first chapter is devoted to examining the theories regarding the meaning and origin of marriage, and generally they account for the lasting association of the sexes on the assumption that in animals, more especially among the anthropoid apes, there is an uninterrupted sexual capacity. It is also pointed out that the marital and parental instincts seem to be necessary for the existence of certain species, and consequently the male and female of such species keep together after the breeding season, thus providing the necessary basis of marriage, which according to Westermarck's original definition is "a more or less durable connection between male and female, lasting beyond the mere act of propagation till after the birth of the offspring." Stripped of the accretions imposed upon it by the church and society, marriage is fundamentally the lending of a woman's body for the use of man who for the pleasure of it, supports her; it differs from prostitution in the fact that in the latter the leasing of the body is periodical and more than one man is involved. Marriage takes its origin not primarily from the sexual congress, but from the habit of man and animals leading a gregarious life for the purpose of protection, and breeding is subordinate to the more dominant concern of the safety of the group. A communal life with primitive instincts of protection implies the existence of promiscuous sex relationship, and the evolution of the family idea follows the shifting of man's allegiance from the community to the individual. The stabilisation of the family is based on the gradual discovery by man that it is capable of functioning as an efficient and self-contained economic unit, organised for self-protection, and the idea that exogamy materially increases the economic and defensive power of the family is perhaps the foundation of the cruder forms of social organisation. Where, however, animals are superiorly endowed, they have remained solitary, and their sexual association is fugitive, the female undertaking the protection and education of the offspring till the latter are sent into the world. Primitive man being defenceless, he must have banded himself into groups for protection from wild beasts and must have found common shelter against the inclemencies of weather, a mode of herd life best fitted for survival; and loyalty to the community being most advantageous in primitive life, is reflected in modern civilisation as social and racial instincts.

Whether promiscuity of sex relationship preceded or not the regulation of individual sex relationship in the human race, is not to be judged by the ethnic evidence based on researches of the surviving savage groups, but we should go back to their predecessors, for the existing savage tribes have been undergoing a process of development, though within a limited sphere, and as the result of this influence many of their customs and habits must have undergone a corresponding evolutionary change. No social anthropologist can maintain, that the existing

primitive groups have retained unaltered the picture of life as lived by their ancestors, however static such groups might appear to the more rapidly changing modern world. Professor Westermarck might perhaps agree with the views of Iwan Bloch and Briffault, if he should extend his researches into the condition of human existence immediately preceding the tribal organisations, before their bundle of customs, laws, superstitions and taboos came into existence.

The second chapter deals with the three essentials of normal marriage, *viz.*, sexual impulse, the relation between husband and wife apart from it, and procreation, which are all sources of much happiness. The chapter also includes a discussion on birth control and love on each of which opinion is bound to differ.

The subsequent chapters treat of subjects such as the causes of matrimonial unhappiness,—sexual maladjustment, adultery and jealousy, and they contain a wealth of information, which, while necessary for a comprehensive knowledge of these social problems, shows that no two anthropologists hold the same opinion. These topics cannot be treated on the rigid basis of the exact sciences and the conclusions cannot be expressed with any degree of mathematical precision and accuracy. The reason is obvious. The causes and factors which are investigated by the social anthropologists are too many and too diversified, besides being obscure, to be comprehended as the simple elements of a single physical or chemical phenomenon, and the nature of the subject therefore lends itself more for metaphysical speculation than experimental verification. Where questions of interpretation arise, there is always ample room for divergence of doctrines, and we shall briefly examine some of them. In Chapter XI there is a clever discussion of sexual behaviour and morality, and dealing with abnormal behaviour, Westermarck points out that "generally speaking there is a remarkable lack of inclination for sexual intercourse between persons who have been living closely together from the childhood of one or both of them. This has been recognised by various writers as a psychological fact proved by common experience, and is attested by statements from different parts of the world. Even among the lower animals there are indications that the pairing instinct fails to be stimulated by companions and seeks strangers for its gratification. This indifference is very generally combined with sexual aversion when the act is thought of,—aversions that are generally felt lead readily to moral disapproval and prohibitory customs and laws." This is the theory of incest. Westermarck, however, recognises that in ancient times kings and ruling chiefs permitted their children to marry each other with the aim of maintaining the purity of the royal blood. Historians and anthropologists inform us that during the early stages of the evolution of societies, ties of kinship which modern man treats with respect offered no impediment to sexual unions without any thought of the purity of the blood. It seems to us that the horrors of incest have been engraved on the human conscience with great difficulty and by a long process of education. Westermarck's observations on the lower animals may not be correct in their entirety, for in the gregarious animals brotherhood and sisterhood, which are distinctly human concepts, do not impose obstacles in the way of sexual attraction, and if the male and female members try to secure mates from the neighbouring herds, it is more with the object of adding more members to their community. If there were aversion, then the size of the herd would not grow. In the case of solitary animals, in which brothers and sisters are separated in an early period of life, it would be difficult to maintain that there is in them inherent aversion so as to prevent incestuous intercourse. Besides, is it a fact that there is a lack of inclination for sexual intercourse between persons who have been living close together from the childhood of one or both? We are disposed to think that this lack of inclination manifests at a maturer age, after the individuals have been educated at home, school, the church and society about the sacred character of kinship, the filial and parental duties, obligations and relationship, and during all this prohibitory period of education the sexual ardour between brothers and sisters is systematically and absolutely starved. The effect of such starvation and the influence of social opinion must produce indifference which is strengthened by the desire of gaining and maintaining the good opinion of the society to which the individual is introduced as a member. Is there an inherent aversion between sisters and brothers or is the close companionship a sufficient cause for producing it? It is

rather due to the vigilance and discipline at home, which, joined to the influence of the church and the public opinion of the society, renders the attraction so obsolete as to become incapable of being stimulated at a later period. The horror is not inborn as an integral part of the mental constitution. We can account for the savage communities giving up incestuous practice on the assumption that sooner or later they must have been led to the discovery that marriage of children outside the limits of kinship was an economic gain to the family, and its extension by ties of marriage gave additional strength both for offensive and defensive purposes. The moral idea may not have been at the root of this arrangement, and it was obviously imposed upon incest to reinforce the economic advantage gained by the new departure. We believe that the disapproval of such savage communities as do not practise incest, was the outcome of the stern economic necessities of primitive life, and aversion, in the sense in which Westermarck uses the term, must be foreign to them. The first part of this extremely interesting chapter (XI) is occupied with a clever and convincing exposition of moral concepts as ultimately based on one or the other of the emotions of disapproval and approval.

There are two factors which might militate against the attainment of uniformity in the moral sphere. These are the rapid growth of the economic independence among women and the increasing practice of birth control. The history of the last fifty years bears witness to the growing and continuous influx of women into wage-earning employment, and the effect of economic change on the moral sentiments on the one hand, and the continuance of dependence of women on mariage for livelihood on the other, must be far-reaching, unless counteracted by other forces which are at present obscure. Westermarck thinks that because the instinct of family life is part of the animal inheritance of man, marriage is bound to survive the modern economic revolution, but even from economic considerations it is perfectly arguable that in the distant future the marriage tie is likely to be relaxed, favouring the tendency to irregular unions, though Westermarck thinks that children will be the deciding factors of the continuance of marriage as a social and economic institution. The argument of children loses ground when we reflect on the influence of the extensive practice of birth control on morality.

In certain views advocated by Westermarck, there may be divergence of opinion, but nevertheless we cannot refrain from expressing our admiration of the candour and sincerity with which he has approached the problems, and the truly scientific spirit which characterises his discussion of them. The book will always be treated as a great contribution, and will be widely read with pleasure and profit.

Einführung in die Quantenmechanik. By Dr. E. Fues. Being a Reprint of the Theoretical Part of *Handbuch der Experimental-physik, Ergänzungs-Werk*, Vol. II. (Leipzig: Akademische Verlags-gesellschaft M. B. H.) 1935. Pp. viii + 224. Price Stiff Covers 14 R.M.

After a phenomenally rapid development, the subject of Quantum Mechanics has now reached a stage where its applications to the details of phenomena can be left to ordinary workers and the creators of science occupy themselves with examining the sufficiency of its foundations, its philosophical implications and the directions in which further progress is to be sought. Though the "Copenhagener Geist" inclines to further sacrifice of classical positions in the same direction in which Quantum Mechanics has progressed since its statistical character began to be more and more emphasised, Einstein considers the description of Reality it provides to be incomplete and Schrödinger himself seems to be dissatisfied with its prediction of uncertain values associated with well-defined instants of time. Some doubt is also being cast on the validity of the laws of conservation of energy and momentum in individual processes. The structure of Radiation is the subject of many different theories, and with it, the relation between the particles and waves of wavemechanics forms a chapter which does not admit of certain assertions or final views. At such a stage an exposition of the present position with emphasis on the implications and limitations of current methods is a great desideratum and the work of Prof. Fues eminently supplies the want. The publishers have rendered a service to many readers by thus re-issuing the work of one who was associated with Schrödinger in those eventful days when wave-mechanics was born and grew so rapidly, and making it available in this

handy and cheap form. For fourteen Marks we thus get a book packed with information and its possessor will not look in vain for instruction on any aspect of Quantum Mechanics except the insufficiently established and rapidly changing subject of Quantum Electrodynamics with its numerous, conflicting and only partially successful theories. Matrix methods, however, are not presented in any detail, the emphasis being naturally laid on Schrödinger's methods, but Dirac's theory of the electron and positron is given in detail and a good deal of space is devoted to the wavemechanics of systems and the approximation methods of Hartree for example. Heisenberg's work also has been freely drawn upon, particularly his "Physikalischen Prinzipien der Quantentheorie". Thus his beautiful discussion of the uncertainty principle in its application to various hypothetical experiments is fully summarised in a small number of pages. To save space, the main theory is given in ordinary print while details and examples are set in small type. Even with this device the compression necessary has sometimes been rather excessive. For example, the demonstration that a Gaussian distribution of errors is the one which leads to a minimum value for $\triangle p . \triangle q$ occupies two full pages in Heisenberg's book but is here compressed into a quarter of a page by quoting a few steps here and there. For the same reason mathematical results are freely assumed, *e.g.*, the method of determining the eigenwerte is not given in connection with the oscillator and the rotator. The polynomial method is, however, shortly illustrated in connection with the hydrogen atom. In fact, the notes in small type appended to the various sections provide an almost complete resumé of the applications of quantum mechanics to atomic theory. The diffraction of matter waves and impact phenomena form the subject of another chapter. Although originally appearing as an article in the *Handbuch der Experimental physik*, the volume is of even greater use in its new form. The present situation leads one to the hope that this volume may be supplemented by a second part in the way in which Born's *Atom-mechanik* was, fulfilling the prophecy he so happily expressed by calling his book of 1924 'Part I'. The printing and get-up are of the same uniform excellence which we associate with the *Handbuch der Experimental physik*. Our thanks are due to the Publishers for making this excellent work easy of reach to a wider circle of readers.

T. S. S.

The Chemistry of Synthetic Resins. By Carleton Ellis. 2 Volumes, Illustrated, Medium 8 vo. (Reinhold Publishing Corporation, New York.) 1935. Pp. 1615. Price £4–17–6.

The more exacting and descriminating demands of a flourishing industry offer the necessary stimulus for conducting research through which its requirements are satisfied. This process often leads to unexpected results of far greater importance than the one anticipated and incidentally opens out possibilities of creating newer products of far greater utility, and the field of synthetic resins is replete with innumerable examples of this kind.

The phenomenal growth of the finishing, the plastics, the insulating and the bonding industries during the past decade, has been entirely responsible for the vast amount of research that has been carried on and for the bewildering variety of resins which have been produced. This enormous research activity is reflected in the two monumental volumes on the Chemistry of Synthetic Resins under review.

The creation of the innumerable species of synthetic resins, a comprehensive literature survey of which is provided by the present work, has been rendered possible by the wide range of raw materials which have been harnessed in their production. Although every product synthesised in the test tube has not been commercialised, it has contributed towards systematising our knowledge of the causes and nature of resinification, a discussion of which appears in the earlier chapters of the first volume. The commercial success of a synthetic resin, however, depends upon the relative inexpensiveness and availability of the raw materials.

Each class of the resins has been systematically treated; the chemistry of their formation and the technology of their production are described in detail. This is followed by a description of its mechanical and electrical properties and its behaviour and adaptability as a raw material for various industries. Sufficient technical information has, therefore, been included in the volumes and has been presented in a manner so that an experienced and versatile industrialist will be stimulated to think of new applications of the product. Special attention has

been paid to the adaptability of the product for plastic moulding.

The volumes, therefore, constitute a thoroughly documented and highly authoritative fount of information on all that is to be known on the chemistry of synthetic resins and its technological applications.

M. S.

Comprehensive Treatise on Practical Mechanics. By J. M. Lacey, M.I.C.E. (The Technical Press, Ltd., London.) 1936. Pp. vi + 320. Price 18*sh.*

Books on Mechanics generally contain only the theoretical principles of the subject, while the application of these principles in actual practice is dealt with in treatises on Applied Mechanics. It was a happy idea of Mr. Lacey to combine these two aspects in his book *A Comprehensive Treatise on Practical Mechanics.*

The book is divided into two main parts, with an introductory first part dealing with the general laws of gravity, mass, force and velocity. Part two deals with the principles of statics, *i.e.*, of the action of forces on bodies at rest and part three treats of dynamics, *i.e.*, of the action of forces on bodies in motion. In both parts, the fundamental laws of Newton are taken as the basis from which the principles involved in designing framed structures, beams, masonry dams, fly wheels, etc., are evolved. A few more practical examples, such as those of the action of governors, on the effect of motion in a resisting medium, the action of springs, and constrained motion such as that ordinarily found in machines, would have made this volume more comprehensive. The book is carefully written and shows that the author has almost thoroughly mastered his subject. A study of the book will give the reader a good grasp of the fundamentals of Engineering—which, after all, is practical Applied Mechanics. The practical engineer, if he goes through the book, will find his time well spent, as it will give him the necessary theoretical knowledge for interpreting many practical problems in a reasoned way. It will be a good addition to his library.

K. B. K. R.

A Treatise on Screws and Worm Gear, their Mills and Hobs. By P. Carmac. (Chapman & Hall, Ltd., London.) 1936. Pp. xi + 138. Price 21*s.*

The book supplies a long-felt want by the designers of mills and hobs. Major portion of the book deals with the mathematical analysis of the properties of movement, helicoids and envelopes, which is necessary for the correct design of gears and hobs. An idea of the contents of the book can be obtained from the following extract from the preface to the book.

"The introductory chapters give the general properties of motion with special emphasis on screw motion, the envelopes of surfaces having screw motion, and the geometry of the helicoid. The application of the theory to the solution of technical problems on the standard forms of screw and worm thread is then proceeded with and the tool forms for their production are investigated. These include thread mills and hobs. Reciprocating rack cutters are examined as special cases of rotary cutters. By the analysis of screw motion into a pair of instantaneous rotations a relatively simple treatment of the subject becomes possible; the mill or hob conjugate to a given screw thread is determined by methods analogous to the familiar method of the instantaneous centre of rotation for conjugate tooth profiles in plane motion. The converse problem, the type of screw thread, generated by a given form of rotary cutter or hob, is also solved. In every case the curve of contact of cutter and screw is obtained. The discussions on worm threads are extended to spiral and helical gear teeth, hobs for spline shafts and polygon profiles and single position hobs. The book concludes with a chapter on worm gear contacts in which both graphical and analytical methods are given for the construction of the surface locus of contact of worm and worm wheel."

The book has been well written and illustrated with examples wherever necessary. It should find a place in all technical libraries.

E. K. R.

Organic Synthesis, Vol. XVI. Edited by J. R. Johnson. (Chapman & Hall, London; John Wiley & Sons, New York.) 1936. Pp. 104. Price 8*s.* 6*d.*

The present volume gives the preparation of 28 substances and in an appendix some later references to the preparations in the preceding volumes. Some additions and corrections for the previous volumes are also included. It is needless to say that the

present volume has maintained the high standard attained in previous volumes. 'Organic Syntheses' have now become indispensable for research laboratories all over the world. The appearance of a new volume is eagerly looked forward to, by organic chemists. The present volume will not disappoint them.

The volume contains the following preparations.—(1) Alanine ; (2) 4-Aminoveratrole ; (3) *n*-Butyl Nitrite ; (4) *n*-Butyl Phosphate ; (5) Coupling of *o*-Tolidine and Chicago Acid ; (6) Sym.-Dimethylhydrazine Dihydrochloride ; (7) Unsym.-Dimethyl hydrazine Hydrochloride ; (8) 2, 5-Dimethylpyrrole ; (9) 1, 4-Diphenylbutadiene ; (10) Epichlorohydrin and Epibromo hydrin ; (11) Ethyl Phenylmalonate ; (12) Ethyl *n*-Tridecylate ; (13) *n*-Heptoic Acid ; (14) *n*-Hexaldehyde ; (15) Isonitrosopropiophenone ; (16) Methyl Benzyl Ketone ; (17) Methylhydrazine Sulphate ; (18) *p*-Nitrobenzyl Bromide ; (19) 4-Nitrophthalic Acid ; (20) 4-Nitrophthalimide ; (21) Pelargonic Acid : (22) Phenanthrene-2- and 3-Sulfonates ; (23) Phthalaldehyde Acid ; (24) Phthalide ; (25) Quinone ; (26) Succinimide ; (27) Tetrahydrofuran : (28) Sym.-Trithiane. The reviewer has already repeated one or two preparations, *e.g.*, that of succinimide and 4-nitrophthalic acid and found, as is usual with this series, that the yields are exactly as stated. The preparations like phenanthrene-2- and 3-sulphonic acids, pelargonic acid, isonitrosopropiophenone would be extremely useful in view of certain recent developments which require these as starting materials.

J. N. R.

Practical Problems in Botany. By W. W. Robbins and J. Isenbarger. (John Wiley & Sons, Inc., New York ; Chapman & Hall, London.) 1936. Pp. 402. Price 10 *s.*

Botany, the science of plants, claims dominion over more than ninety-five per cent. of the living matter on the surface of the earth. It offers unbounded scope for a study which is both attractive and imposing for young people.

Opinions differ as to what should constitute an elementary course in Botany. It must be remembered that only a few of our Intermediate students can take up University courses. Several of them go to medical schools and colleges and an increasing number take up the study of agriculture, but there always remains a large residue of others, who have to stop their instruction entirely and merely add to the unemployed.

To the student in all these categories, except the first, it is urgent that the first course in Botany should serve as a general introduction to the subject—a respectable minimum that must form a part of the intellectual equipment of every educated citizen.

The authors have provided us with an excellent little book that meets this purpose admirably. As the title itself suggests, the plan of presentation is essentially practical and for a proper appreciation of the facts given in the book the student must do a considerable amount of practical work not only in the laboratory, but also in the garden and the field.

At the end of every chapter there is a small list of exercises and questions which force the student to do some of his own thinking, but in most cases the answer will come forth readily. For more serious students there is a useful list of references which appears to have been selected with great care.

Throughout the text there are suggestions and interpolations on the possibilities of improvement of the home environment based on an intelligent application of the knowledge of the principles of plant growth. Culture of indoor plants, vegetable and flower gardening, preservation of foods, bacteria and their relation to disease as well as soil fertility, all find their due share. In Chapter V there is a good discussion of the failure of flowers to set fruit and the last chapter gives a particularly atractive account of the ways in which plants affect the lives of man.

The reviewer read through the book with the greatest interest—almost at one stretch —and he shares the hope of the authors that, if properly used, it will lead the student to the development of the elements of scientific thinking and increase his personal efficiency by making him a more cultured citizen.

It is a little disappointing to find that in such a well-written text some of the illustrations are amateurish, but there can be no denying that a book like this should be recommended for collateral reading to all of our elementary students who, in the preparation for the inevitable examinations, often lose a great deal that they must know.

P. MAHESHWARI.

Zoology for Intermediate Students. By Vishwa Nath, M.Sc. (Panj.), Ph.D. (Cantab.), F.R.M.S. (Uttar Chand Kapur & Sons, Lahore.) 1936. Pp. iii + 495 + xvii, one coloured plate and 176 figures in text.

By the publication of Dr. Vishwa Nath's text-book of *Zoology for Intermediate Students* the beginners in the subject are now provided for the first time with a lucid and not very technical account of the common Indian "types" studied in almost all the universities of the country. The appearance of such books is commensurate with the increasing popularity of the subject in the university curriculum and its great bearing on the problems of agriculture, veterinary, animal husbandry, etc. Dr. Vishwa Nath is a gifted writer and being himself a lecturer to the Intermediate students of the Panjab University has exercised considerable care in not overloading the book with details not required by the beginners. For the sake of clarity he is obliged in places to give details but they are placed in smaller type so that the average students can pass over them in their first reading, while the brilliant students may benefit by the additional information provided in them.

The author has found from his experience of teaching that the following plan is very useful to initiate the beginners in the subject: "The preliminary lectures to the recruits should be on the meaning and scope of biology, properties of living objects, chemical and physical structure of protoplasm, physico-chemical conception of life, spontaneous generation, source of protoplasmic energy, saprophytism and parasitism, and a bare statement of the cell-theory and the cell. After this grounding in general and fundamental phenomena of life, the teacher might start lecturing on the types. A beginning may be made with the frog which, in spite of what has been said to the contrary, is still the most convenient principal type,—and then through *Amœba*, *Paramœcium*, malarial parasite, *Obelia* or *Hydra*, *Pheretima*, and Cockroach on to the Rabbit. Now will be the time to do principles of classification and a general survey of the main animal groups with special reference to ecology. The teacher might then revert to general zoology and deal with cytology, evolution and genetics, using his own discretion as to how much he has to say. For, in the author's view, general zoology has been dealt with in the book in some detail and this should make the book useful to the B.Sc. students."

The book is divided into 28 chapters, of which the first 10, comprising 123 pages, are devoted to general zoology. Chapters 11 to 26 give a treatment of "types" and of these 10 chapters are devoted to "Frog". The other types dealt with in the book are *Amœba*, *Paramœcium*, Malarial Parasite, *Hydra*, *Obelia*, Earthworm, Cockroach, and Rabbit. In the last two chapters, principles of classification and a general survey of the animal kingdom is given.

After a careful perusal of the book the reviewer endorses the view of Prof. George Matthai that "Students of Intermediate Zoology will find in this book a clear and concise statement of the essentials of Zoology."

S. L. H.

The Geological Map. By Kenneth W. Earle, D.Sc., F.G.S. (Methuen & Co. Ltd., London.) 1936. Pp. vi + 92. Price 3*s*. 6*d*.

This is a small hand-book of structural geology, with special reference to the study and interpretation of geological maps, intended for elementary students of geology and geography. Within the short space of about a hundred pages, the author briefly describes the various important structural features commonly noticed in rocks, giving actual examples from the geology of the British Isles. Pointed emphasis has been laid on important conclusions which the student has constantly to bear in mind while studying geological maps. The treatment of the subject is definitely of a practical character and the book is profusely illustrated, the chief method of illustration used being that of solid models which will greatly help the student to visualise geological structures "not only from the aspect of the surface map but also simultaneously in sections both in the directions of the dip and the strike of the strata". In his own words, the author's objective in writing these pages "has been to produce a book which, by the use of only the most simple language, and by the suppression of all superfluous detail, shall be intelligible to students of geography and geology alike"; and there is no doubt that he has succeeded in doing this. The general get-up of the book is excellent.

L. RAMA RAO.

Spiders of Lahore. By Sukh Dyal, M.Sc. (*Bull. of the Dept. of Zoology, Punjab University. Fauna of Lahore*, No. 4.) 1935. Pp. 119–252. Price Rs. 4–8–0.

The idea of publishing zoological bulletins embodying the results of study of Indian fauna is laudable enough but when the publication reaches a standard of the type attained by the volume under review, it becomes a distinct asset to Indian zoological literature. Mr. Sukh Dyal has attempted a task of immense difficulty and has creditably achieved it.

The material for the study has been collected from the town of Lahore and its outskirts and comprises 121 species belonging to 65 genera and 20 families. Of these 46 species are new to science. The author has deservedly paid great attention to the Attid group of spiders, which have received very meagre consideration at the hands of systematists in India and he claims to have discovered 16 new species in this family alone.

A useful account of the external anatomy of a spider is given at the outset followed by a key to the families of spiders found in Lahore. The species are treated in great detail. A useful glossary is given at the end, and also a complete bibliography. The illustrations are excellent and the get-up of the volume, printed at the Civil and Military Gazette, Lahore, leaves nothing to be desired.

We congratulate Mr. Sukh Dyal on his excellent achievement and hope that his work will stimulate zoologists in other provinces to engage in similar faunistic researches which would add to our existing knowledge of the different groups of animals.

B. R. S.

Cotton Research in India. (Being an account of the work done at the Indian Central Cotton Committee Technological Laboratory, 1924–1935.) By Nazi Ahmed, M.Sc., Ph.D., Director. (The Times of India Press, Bombay.) 1936. Pp. vi + 100. Price Rs. 2.

It was a happy idea on the part of the Indian Central Cotton Committee to have brought out in a semi-popular form this compendious account of the work in their Technological Laboratory in Bombay during the twelve years it has now been in existence. Started primarily to assist cotton breeders throughout India in their work of raising improved varieties by furnishing them with a correct assessment of the different strains in respect of their spinning value, the Laboratory has been steadily adding to activities so that its work now embraces many lines of research both of a fundamental nature as well as those of immediate practical value to the mill owner and the cotton trade in general. Seeing that a spinning test is still the final arbiter of the value of any cotton, the laboratory has been a necessary and most important auxiliary in the work of cotton improvement and its help has accordingly been extensively availed of by all the agricultural departments in India engaged in the improvement of cotton. In addition to the laboratory determinations of the length, fineness, strength and other qualities of the cotton fibre the valuation of the samples relates to large-scale spinning tests of the yarns on actual mill machinery under conditions that make the valuations not only precise but also more accurately comparable. The devising of methods to give a quantitative expression to the qualities of the cotton fibre and thus to eliminate the personal factor which now largely prevails in the valuations has indeed been the scope of this branch of the work. The studies with a view to arriving at a "prediction" formula for the value of a cotton from data relating to its fibre qualities may be selected for special mention in this connection and it is interesting to note that practically two among the fibre properties, *viz.*, the mean fibre length and the mean fibre weight per inch decide its spinning value, a fact which is of great practical interest to the cotton breeder. Tests and valuations for breeders have amounted to more than 1,600 and the huge increase in the areas under varieties like Banilla, Jayavant and the Verum selections and of the consequent increase in the profits of the cultivator are claimed as the result. A parallel to such fruitful co-operation can only be found in the improvement of wheat both in India and elsewhere on the results of milling and baking tests.

Studies have also related to the influence on the fibre of season, of irrigation and the moisture in the soil, and of manuring which last, however, needs to be pursued further as it deals with a controllable production factor. Quite a large amount of work has been done on problems of great practical interest to the

mills, such as spinning methods and technique, methods of storage of cotton, the injurious effect of adulteration on the quality of the yarn, the moisture content of baled cotton of different types, and the effect of temperature and humidity in the mills on the cotton and the yarn. A study to find out the limit of spinning performance of various Indian cottons, brings out the interesting fact that Cambodia Co. 1 may be spun up to 52's, and even up to 60's under special conditions.

Among the services of the Laboratory to the cotton trade in general we may mention the arrangement for examining and valuing samples submitted and the comparative valuation of the samples of average quality of the chief trade varieties furnished officially by the Mill-Owners' Association of Bombay at the beginning of each buying season which are, of course, highly appreciated. The law prescribing the entry of all American cotton only through the port of Bombay and its fumigation as a control measure against the cotton boll weevil is due entirely to the efforts of the Laboratory through whose agency all this work of fumigation is now being carried out. The book makes it amply clear that the Laboratory has been of great service to all the cotton interests in the country, the grower, the trader, and the mill-owner alike.

We venture to think in this connection that cotton research in India will soon have entered upon a new and more intensive phase to enable cotton to maintain its position against competition from its new rival, "staple" fibre. Just at present this is negligible but it is nevertheless a portent like the cloud now no bigger than a man's hand. Most extraordinary claims are made for it, many countries are exploiting it and, despite imperfections and high cost, even now there is a fair quantity imported into India; and if one recalls to mind how "rayon" was perfected, cheapened and popularised it cannot be difficult to visualise the time when "staple" fibre will become a formidable rival to cotton. The cotton industry will, in the coming struggle, have to rely on the resources of science much more largely and the Laboratory will be called upon to play a still more important rôle with its scope widened to include not merely the cotton fibre but many other products, the cotton plant as well.

A. K. Y.

CENTENARIES.

By

S. R. Ranganathan, M.A.

(*University of Madras.*)

Samuels, Edward Augustus (1836-1908).

E. A. SAMUELS, the ornithologist, was born in Boston, Massachusetts, on July 4, 1836. He inherited from his father his deep interest in outdoor life. During most of his career, he was employed in the Massachusetts State Board of Agriculture. His duties allowed him ample leisure for other pursuits. He spent his leisure in the study of birds and their habits.

His Publications.

He recorded the results of his observations in the *Reports* of the Board of Agriculture. Encouraged by the wide interest his results aroused, he brought out in 1867 his well-known book *Ornithology and Oology of New England*. The book was so good that the State purchased a thousand copies for distribution to the public libraries. The book went through several editions and the 1870 edition came out with the altered title *The Birds of New England*. It is rightly estimated that this book stimulated bird study in New England more effectively than any other publication of the period.

Hunting with A Camera.

Another book of his entitled *With Flyrod and Camera* and published in 1890 broke new ground in another way. It is said that it was perhaps the first publication to suggest the hunting with a Camera instead of a gun.

Conclusion.

His wide interest in the bird life and the influence he gained through his publications led to his election as President of the Massachusetts Fish and Game Protective Association. He held this post from 1885 to 1891. During this period, he did much to improve the laws of the land relating to the protection of animals. Though he became blind in his old age, he continued writing to *Forest and Stream* till his death on May 27, 1908. Among his contemporaries, he was regarded as the best-informed man on the natural history of his country.

Mapes, Charles Victor (1836-1916).

C. V. MAPES, who was born in New York City on July 4, 1836, was endowed with a versatile and brilliant mind and a bent toward applied science. Even while he was a student at Harvard College, he had fitted up a laboratory in his own room. As the state of his health prevented his studying medicine, as originally planned, he took up work in 1858 in a firm of whole grocers. In the next year, he established a factory near Newark for the manufacture of agricultural implements and fertilisers. He also took over the management of his father's paper *The Working Farmer*.

MAPES'S FERTILISERS.

Mapes was a pioneer in scientific agriculture. His special field was agricultural chemistry. In 1874, he produced the first special crop manure. This was for potatoes. He contributed several informing articles on chemical manures to the *Reports* of the New Jersey State Board of Agriculture and to several agricultural periodicals.

CONCLUSION.

In 1877 he became Vice-President and General Manager of the Mapes Formula and Peruvian Guano Company and later became its President. For a while, the Department of Agriculture of the Federal Government utilised his services in soil tests. He died on January 23, 1916.

Eastman, John Robie (1836-1913).

J. R. EASTMAN, the American astronomer, was born in Andover on July 29, 1836. He got his M.Sc. degree from the Dartmouth College in 1862. Shortly after this, he was appointed assistant astronomer at the Naval Observatory. In 1865, he became professor of mathematics and continued to be so till 1898.

CATALOGUE OF STARS.

He was an intimate associate of the astronomers, Newcomb and Hall. His contributions added not a little to the reputation of the Naval Observatory. From 1872 to 1882, Eastman was the editor of the publications of the Observatory. But the chief work of his life is the monumental volume entitled *Second Washington Catalogue of Stars*, which came out in 1898. It embodies the observations of several years with the meridian circle.

He was engaged in total solar eclipse expeditions in 1869, 1870, 1878 and 1882. He also took part in the determination of the longitudes of certain places in the United States.

CONCLUSION.

At various times, he was President of the Philosophical Society of Washington and of the Washington Academy of Sciences. He was also Vice-President of the American Association for the Advancement of Science. In addition to his astronomical contributions, he published in 1910, a book of considerable genealogical value, entitled *History of the Town of Andover*. He died on September 26, 1913. He contributed 21 articles to the scientific periodicals of the nineteenth century, his first paper entitled *On the Altitude of Kearsage Mountains in New Hampshire* having appeared in 1869 in V. 48 of the *American Journal of Science*.

Pickel, Ignaz Balthasar (1736-1818).

IGNAZ PICKEL, the German Jesuit and mathematician, was born on July 30, 1736. He was professor of mathematics in the University of Dillingen, which was then the intellectual centre of Catholic Germany, though it was dissolved in 1804. His first book entitled *Elementa arithmeticæ algebræ ac geometriæ, etc.*, 2 T, 1771–72, was a popular text-book in Germany and went through several editions. He wrote nine other books. The Royal Society's index lists two of his papers. He died on October 16, 1818.

The London Shellac Research Bureau.

By Lal C. Verman, M.Sc., Ph.D., F.Inst.P.

SINCE 1929 the Indian Lac Cess Committee has maintained in London a Special Lac Inquiry Officer to provide the necessary liaison between lac producing interests in India and lac consumers in England, Europe and America. In this way a large amount of technical information, including a comprehensive bibliography, has been collected, and a number of the problems confronting consumers of lac have been examined in the light of modern conditions. It soon became apparent that the study of problems arising out of the application of lac could be best carried out near to the centres of consumption and that a research laboratory located in London would be able to provide that necessary service which consumers to-day expect. Consequently in 1933, the Indian Lac Cess Committee founded the London Shellac Research Bureau under the chairmanship of the High Commissioner with an Advisory Committee, the Special Officer, Lac Inquiry, and three Indian scientists, two of whom were chemists and one a physicist.

In the past three years the activities of the Bureau have been manifold. Some description of the work done will be found in the *Annual Reports* of the Special Officer (Mr. A. J. Gibson) but the present writer is mainly concerned with indicating and commenting upon some of the research work carried out by the staff. After a short time together at the Paint Research Station, Teddington, one of the chemists (Dr. A. Karim) was posted to Mr. Bayley Parker at the Research Laboratories of the British Thomson-Houston Co., at Rugby, and his work has been mainly concerned with the development of a buying specification for lac products in the electrical industries, to be approved by the International Electrotechnical Commission Advisory Committee No. 15, of which the Special Officer, Lac Inquiry, is chairman. This has involved a mass of research and analyses by standardised methods, work which is approaching completion. Dr. Karim has also compiled a monograph of general interest discussing the various problems of lac chemistry.[1]

The other chemist (Dr. R. Bhattacharya) and the physicist (the writer) remained at the Paint Research Station and have worked in close collaboration with each other at this Station, Teddington, of which Dr. Jordan is the Director.

The first work was to collect and consider the value of the published work on lac; in this way much valuable data have been presented in its proper perspective. Some of it has already been published in the form of critical summaries [2,3,4,5,6] but a considerable amount of material still remains to be presented in similar form. The current literature on lac has been continuously abstracted and printed as a special section of the Paint Research Station bimonthly *Review*. These abstracts are reprinted semi-annually in a collected form by the London Shellac Research Bureau.

The numerous enquiries received from lac consumers and dealt with during the three years cover a large field of application; some of the objects treated, included the preparation and testing of lacquers and finishes for various purposes such as artificial leather and leather goods, tin and aluminium foils, rubberised fabric; the study of processes for dewaxing of lac and the impregnation of cotton covered copper-wire; the production of cellulose-lac combinations; the testing and evaluation of new plasticisers and the study of problems arising out of the thickening of lac-copal solutions, and the manufacture of adhesive compositions. The general impression gained from these enquiries is that the consumer is anxiously waiting for convenient methods of increasing the softening point of lac and improving its water resisting qualities. These fundamental problems, so often referred to in lac literature, and others have received close and critical attention at the Teddington laboratories with a certain measure of success.

In dealing with any material, the first question and one of fundamental importance is "constitution," a thorough knowledge of which is absolutely necessary before any *systematic* study can be made leading to modifications showing improved and desirable properties. Some years ago Dr. Werner Nagel and his colleagues isolated and identified in lac two major acids—aleuritic and shellolic, although the correct formula for the latter is still uncertain. Dr. Bhattacharya's work[7] in this direction has revealed that the former can be easily isolated and purified, whereas the latter being very sensitive to the usual chemical reagents is difficult to obtain in a pure state. There are indications that this acid lactonises readily and indeed it has been found to exist in more than one isomeric form. He has, however, worked out a simple method[8] to isolate and purify shellolic acid, which depends on the relative solubilities of the lead salts of the lac acids in water. From the study of these comparatively pure materials it is evident that the iodine value of lac resin must be attributed to some component other than shellolic acid and not yet identified. This work and other related investigations have led to the derivation of a tentative monomeric formula for the major resinous constituent of lac—pure lac resin, which agrees with most of its known experimental constants.[9]

It has been known for a long time that shellac resin contains a hard and a soft component, the latter being ether-soluble. The work of Tschirch

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[1] A. Karim, *J. Oil & Col. Chem. Assoc.*, May 1935, **18.**

[2] R. Bhattacharya, *Lond. Shellac Res. Bur. Tech. Paper*, June 1935, No. 2.

[3] L. C. Verman, *Lond. Shellac Res. Bur. Tech. Paper*, July 1935, No. 3.

[4] L. C. Verman, *Lond. Shellac Res. Bur. Tech. Paper*, Aug. 1935, No. 4.

[5] L. C. Verman, *Lond. Shellac Res. Bur. Tech. Paper*, May 1936, No. 7.

[6] L. C. Verman, *Lond. Shellac Res. Bur. Tech. Paper*, to be published shortly.

[7] R. Bhattacharya, *J. Soc. Chem. Ind.*, March 22, 1935, **54.** Also *Lond. Shellac Res. Bur. First Bull.*, March 1935.

[8] R. Bhattacharya, *Chem. and Ind.*, April 17, 1936, **55, 309.**

[9] L. C. Verman and R. Bhattacharya, *Lond. Shellac Res. Bur. Tech. Paper*, to be published shortly.

and Schæffer, Harries and Nagel and others has, in a general way, indicated that the harder ether-insoluble component is chiefly responsible for the excellent properties of shellac. Our recent work has substantiated this view,[10] and the various means of isolating this hard component, which constitutes about 75 to 80% of lac, have been investigated[11]; of the methods available it has been found that a direct solvent extraction process is not only practicable and advantageous in several respects but is also likely to be a commercial possibility.[12] A semi-industrial scale pilot plant was constructed last year and the experience gained has brought the process to a stage where it can well be taken up by an industrial organisation.

The properties of this material, which has been named "Hard Lac Resin" in preference to the term "Reinharz," have been investigated in great detail[13] and it has been found to be superior to the parent lac in almost all respects. For example it is higher melting, is much more water-resistant, much quicker heat-hardening, possesses a higher degree of adhesive properties, yields harder and more flexible films, whilst the solvent retention of its films is negligibly small. In one respect, colour, it is inferior to whole lac; it can, however, be decolorised to a considerably greater extent than lac by means of a little oxalic acid or the like. It can also be bleached like ordinary lac, although this process has not yet been fully investigated. Furthermore, as it does not react with copper, no green discoloration is produced as is the case with lac under certain conditions. Other properties which make this material highly suitable for electrical insulation work are its higher breakdown voltage and its capacity to withstand high temperatures for prolonged periods of heating.

A general survey of the known physical properties of lac has indicated the need for a more detailed and systematic examination of most of them, especially those properties that are immediately important from the point of view of industrial application of lac. Investigations in this direction have yielded extremely interesting results of technical as well as theoretical importance. The following subjects have thus far reached the first stage of publication :—

(1) Darkening of Lac Solutions and the Effect of Oxalic Acid Thereon.[14]

It is well known that lac solutions stored in tinned iron containers have a tendency to discolour with time and it is also well known that a small proportion of oxalic acid added to the solution has an inhibiting effect on this process. So far, no satisfactory explanation has been known for this phenomenon, nor has it been possible to determine the necessary amount of acid required to produce the effect. Our studies have revealed that on addition of acid to lac solutions the electrical conductivity of the latter decreases at first, passes through a minimum and then slowly rises. By a complicated series of conductivity measurements it has been shown that the minimum conductivity point, which varies from sample to sample between concentrations of about 0.025 and 0.25% of acid on lac, is definitely related to the anti-corrosive action of oxalic acid. The mechanism appears to be that the addition of acid precipitates the inorganic impurities in shellac as oxalates, which causes a depression in conductivity. A slight excess of acid over and above the minimum conductivity point helps to establish an equilibrium between the corroding iron surface, oxalic acid and iron oxalate, which is formed in preference to iron-shellac salts. Such an equilibrium prevents the weaker shellac acids from reacting with iron and thus preventing the darkening of the solution. This mechanism seems to explain the known facts for example of conductivity, but the necessity for further work in this direction still exists. It may also be mentioned that the amount of oxalic acid required to give the minimum conductivity to shellac solutions is also the amount necessary to cause the maximum possible decoloration of the solution, so that either electrometric or colorimetric methods can be used to determine the necessary amount of acid for the purpose of inhibiting the darkening of solutions in tinned iron containers.

(2) Plasticising of Lac Films.[15]

The problem of finding a suitable plasticiser and that of comparing various available plasticisers for lac films has been a subject of controversy for some time. A preliminary study of the literature at once indicated that the chief reason for this controversy had been the lack of a systematic study. A comprehensive plan was drawn up, therefore, to study ten well-known and commonly employed plasticisers. The underlying idea of the scheme was to investigate all the properties dependent on plasticising action and to compare the results with the control as well as among themselves. The properties of the film so far studied are :—

1. Tensile strength.
2. Extensibility.
3. Adhesion to metal surfaces.
4. Water-sensitivity including blushing and amount of water absorbed by
   (*a*) detached films,
   (*b*) films on metal supports.
5. Effect of baking on these properties.

Other properties that may be included in the scheme are :—

6. Permeability to water and water vapour.
7. Durability under alternative exposure to dry and moist atmospheres.
8. Durability under normal as well as artificial weathering.

A good plasticiser should prove satisfactory in all these respects. So far, it has been found that among those tested sextol phthalate is the most satisfactory all-round plasticiser for lac.

(3) Hardening of Lac.[13]

In moulding practice, knowledge of the hardening properties of the material is essential and it

[10] L. C. Verman, *J. Soc. Chem. Ind.*, March 22, 1935, **54**. Also *Lond. Shellac Res. Bur. First Bull.*, March 1935.

[11] L. C. Verman and R. Bhattacharya, *Lond. Shellac Res. Bur. Tech. Paper*, Dec. 1934, No. 1.

[12] L. C. Verman and R. Bhattacharya, *Lond. Shellac Res. Bur. Tech. Paper*, Aug. 1935, No. 5.

[13] L. C. Verman, *Lond. Shellac Res. Bur. Tech. Paper*, to be published shortly.

[14] L. C. Verman and R. Bhattacharya, *Lond. Shellac Res. Bur. Tech. Paper*, May 1936, No. 8.

[15] L. C. Verman and R. Bhattacharya, *Lond. Shellac Res. Bur. Tech. Paper*, June 1936, No. 9.

is to be noted with regret that very little is known about lac in this respect. Our efforts so far have been confined to the study of time and temperature relationships in respect of hardening. It has been found that " Life of Lac under Heat " which means the time of heating necessary to reach the beginning of the " B " stage of polymerisation or rubbery, highly elastic state, can be expressed by the equation :—

$$l = ae^{-a\theta} \quad .. \quad .. \quad .. \quad (1)$$

where l is the " life " in minutes,
θ is the temperature in °C.,
and a and α are characteristic constants.

The constant a seems to vary from sample to sample, while α is found to be more or less the same for most lac samples and even for hard lac resin it is only slightly different.

Furthermore, no appreciable insolubility of lac in alcohol takes place before the "life" has been spent ; thereafter insolubilisation proceeds at a rather rapid rate reaching a maximum of about 70-75%, corresponding to the proportion of the pure or hard lac resin component of lac. Then the rate again becomes very slow.

Data obtained by other investigators have also been analysed in the light of the above discoveries. The splitting away of water during the hardening of lac has been connected with the fact that the chemical reactions that take place are chiefly of the condensation type.

(4) Viscosity of Lac and Hard Lac Resin Solutions.[16]

Studies of viscosity also leads to a simple empirical relationship between viscosity and concentration, *i.e.*,

$$\eta = \eta_0 e^{kc} \quad .. \quad .. \quad .. \quad (2)$$

where η is the viscosity of the solution at a given temperature,
η_0 is the viscosity of the solvent at the same temperature,
c is the concentration in terms of gm. of lac per c.c. of solvent,
and k is a characteristic constant.

The constant k is found to vary very slightly from sample to sample but appreciably with temperature. It is slightly greater for hard lac resin than for whole lac, the theoretical implications of equation (2) are unknown, but the variation of k with temperature indicates the formation of aggregates in solution. Equation (2) applies from the lowest concentration to the highest investigated (*i.e.*, from 0.5 to 50%).

Another useful relationship that emerged from these studies was the simple correlation of densities of solutions with their concentrations, expressed as :—

$$\text{Density} = \frac{\text{Wt. of lac} + \text{wt. of solvent}}{\text{Vol. of lac} + \text{vol. of solvent}} \quad .. \quad (3)$$

[16] L. C. Verman, *Lond. Shellac Res. Bur. Tech. Paper*, to be published shortly.

The practical usefulness of equations (2) and (3) is self-evident.

Among the numerous chemical modifications studied, two of them have so far proved to be of considerable technical importance : sulphitation of lac[17] and drying oil-lac compositions.[18]

It has been found that lac can be dispersed in water by the aid of sulphurous acid and alkaline bisulphites. Sulphurous acid dispersions yield water-proof films in which lac appears to be in the "B" stage of polymerisation, while bisulphite-dispersions may be made water-proof by pigmentation to form distempers. In both cases, a reaction appears to take place between the dispersing agent and the hard lac resin component. Large-scale experiments are in progress to test the utility of distempers thus prepared.

Since no other natural or synthetic resin reacts in this manner with sulphurous acid, it appears that the sulphitation process may be successfully developed as an identification test for lac.

The difficulties of dispersing lac in drying oils have long been known but they have been overcome by an ingenious process developed by Dr. Bhattacharya. Lac, bleached lac and even polymerised lac have been found to be easily soluble in fatty acids at moderate temperatures. Such solutions esterified with glycerol yield low acid value and normally drying oil-lac varnishes, which may be pigmented and tinted to give normal oil paints. One most important feature of lac-oil varnish is that it can be combined with cellulose lacquers in any proportion. Thus it is possible to combine in one vehicle the properties of cellulose (high gloss, quick drying, etc.) of lac (hardness, good adhesion, etc.), and of oils (flexibility, weathering, etc). Paints made from such combinations have been found to be highly satisfactory.

The completely esterified product of lac and fatty acids yields a product which, when neutralised with aqueous ammonia, provides a basis for emulsion paints and varnishes. Such emulsions have been used as binding media with various materials to prepare special surfaces.

In conclusion, it may be added that the work of the London Shellac Research Bureau has only just begun and judging from the present state of developments it is not unreasonable to conclude that the future holds unknown and great possibilities. The programme of researches in hand is very comprehensive and with the co-operation of the Indian Lac Research Institute and the United States Shellac Research Bureau, effected through the office of the Special Officer, Lac Inquiry, considerable progress may be expected in the near future.

[17] R. Bhattacharya and L. C. Verman, *Lond. Shellac Res. Bur. Tech. Paper*, Jan. 1936, No. 6.

[18] R. Bhattacharya, *Lond. Shellac Res. Bur. Tech. Paper*, to be published shortly.

RESEARCH NOTES.

MATHEMATICAL AND PHYSICAL SCIENCES.

New Foundations of Projective and Affine Geometry.—Karl Menger (*Annals of Math.*, 37, No. 2, 456–482) has given a very systematic foundation of projective and affine geometry by means of two operators. It is of complete logical character—except for the independence of the axiom-systems which is not gone into by him in the present paper. The essential differences between his new treatment and the usual treatments are the following: (1) all the entities that are introduced belong to one class contrasting with the theory of Hilbert; (2) He does not derive new entities from the entities already defined—in contrast with the treatment of Veblen and Young given in their classical treatise. It is very interesting to note that the difference between projective and affine geometry *w.r.t.* their axiom-systems is brought out very clearly in this new foundation. The idea of dimension appears later.

Menger introduces two operations and a class of entities—A.B and A + B. [A.B ≡ corresponds to the highest dimensional part which is part of A and B – A + B ≡ the least dimensional part which contains A and B.] The following 4 postulates constitute those of projective geometry: (1) The operations are associative. (2) The space (*i.e.*, the totality of entities) contains a class V and another class U satisfying the relations V + A = A, and U.A = A. (3) A + (A + B).C = A + (A + C).B and A.(A.B + C) = A.(A.C + B). This postulate—which contains the commutativity of the operations appears to be the most charcteristic of the system. Part of it is satisfied by the entities of affine geometry also. This gives us a clear insight into the difference between the two geometries. (4) [A ⩽ B means B contains A]. If A ⩽ B ⩽ C, there is a $\bar{B}$ such that B + $\bar{B}$ = C, and B.$\bar{B}$ = A. From these various theorems are derived such as the following—The operations are commutative—The relations A + B = B and A.B = A are equivalent. The point-concept is introduced. [P is defined to be a point if it has no part other than itself and the zero-element V] and various theorems concerning the relationship of the entities with points are derived, *e.g.*, if A ⩽ B < A + P, then A = B etc.

It is to be noted that with the interchange of + and . , V and U, and the interchange of 'contains' and 'is contained in', the axiom-system does not change. [The dual of a point is a hyperplane defined by means of U.] Hence the corresponding dual theorems also are true. Next he gives the common set of axioms of projective and affine geometry. They consist of the axioms (1), (2) and (4) and three others which are deductions of postulate (3). They are (*a*) The two operations are commutative, (*b*) The operations are absorbent. *i.e.*, A + A.B = A = A. (A + B)—this is equivalent to the equality of A + B = B and A.B = A. (*c*) If P is a point and P ⩽ A + B, then A.B = (A + P). B. With the exclusion of (*c*) every one of the axioms is self-dual. The dual of (*c*) is the following (*c'*). If H is a hyper-plane and H ⩾ A.B, then A + B = A.H + B. It is easily seen that (*c'*) is satisfied in projective geometry and not in affine geometry. (*c'*) can be broken into two parts c_1 and c_2, the former alone being valid in an affine space (c_1). If H ⩾ A.B and A.H ≠ V, then A + B = A.H + B. (c_2) If H ⩾ A.B and A.H = V, then A + B = A.H + B. We can also divide (*c*) into two corresponding parts both being valid in both geometries.

The notion of independece of points is introduced—*i.e.*, P_1, P_2, ... P_n are independent if $P_k.(P_1 .. + P_{k-1} + P_{k+1} + ... P_n) = V$ for all k. He proves the fundamental theorem that if A is the sum of a finite number of points then it is also the sum of a finite number of independent points. This paves the way for the introduction of dimension of an entity A = μ^+ (A) as the number of independent points (assumed to be finite) constituting A. [Similarly the dual μ' (A) is introduced. The dimension of A, *viz.*, dim A is defined to be μ^+ (A) – 1.] The properties of μ' (A) in projective and affine systems are naturally different. In order to make the class, one of finite dimensions, he introduces another axiom—*i.e.*, that each strictly monotonic sequence of entities is finite. With projective axiom-system the following known properties of dimension are derived (1) dim V = –1, (2) dim A = 1 + Max. dim A′ for all A′ < A. (3) dim A + dim B = dim A.B + dim (A + B). Next the deductions of axioms of alignment and extension of Veblen and Young are derived. [*i.e.*, the inter-relations between line and points.] An entity A is termed degenerate if there is a line L < A, containing exactly two points and non-degenerate otherwise with the introduction of this concept the following fundamental theorem is of interest.—A finite projective space is the sum of a finite number of Maximal-non-degenerate elements (for details refer to the paper).

Next he comes to an affiine-space. The equivalent of Euclid's parallel postulate is the following:—

If P, Q, R, are three points, no one of which is part of the sum of the two others, then there exists exactly one entity L, such that R < L < P + Q + R and L.(P + Q) = V.

Lastly it is interesting to note that the operations are not distributive. [The distributive property was already shown to be equivalent to the uniqueness of the inverse-operations by Schroder-proofs by Huntingdon—*Trans. Am. Math. Soc.*, 1904, p. 288.] The only results in this direction which can be derived from the four postulates are the following:—

(1) A.(B + C) ⩾ A.B. + A.C. and A + B.C. ⩽ (A + B) (A + C).

K. V. I.

* * *

On Some Extremal Properties of Polynomials.—J. Gerominus (*Annals of Math.*, 37, No. 2, 482–517) has investigated the problem of the extreme values of $\omega(P) = \sum_0^s a_r A_r$, $s \leqslant n$, for all polynomials $P(x) = A_0 x^n + ... A_n$ subject to one of the following conditions: I. $L(P) = \int_{-1}^{+1} |P(x)|\, dx = 1$. II. $\int_{-1}^{+1} |P'(x)|\, dx = 1$. III same

as II with the additional restriction that $P(x)$ is monotonic in the interval. Particular cases of this problem were solved earlier by Korkine, Zolotareff, Fujiwara and Bernstein.

In case $s \leqslant \left[\frac{n}{2}\right]$, the extremum is reduced to that of the solution of a secular equation of degree $\leqslant (s+1)$.

First of all it is shown that in case of the extremum $P(x)$ should have all its roots $\eta_1, \eta_2, \ldots \eta_n$ (ascending order of mag.) between 0 and 1. The problem is transformed by writing

$$P(x) = \sum_0^n B_i\, U_{n-i}(x),\ U_k(x) = \frac{\sin[(k+1)\theta]}{\sin\phi},\ \phi = \text{arc cos } x.$$

Let $\omega(P) = \Sigma\, b_i\, B_i$, where the B_i's can be expressed linearly in terms of the a's. The relation between them is best expressed in terms of two auxiliary polynomials $\phi(x)$ and $\psi(x)$ whose roots are $\eta_1, \eta_3, \eta_5, \ldots$, etc. and $\eta_2, \eta_4, \ldots$, etc. respectively; *i.e.*, If η is odd then

$$\text{Log}\left\{\frac{z-z^{-1}}{2}\,\frac{\psi[\frac{1}{2}(z+1/z)]}{\phi[\frac{1}{2}(z+1/z)]}\right\} = -\frac{1}{\lambda}\sum_0^t \frac{b_i}{Z^{n-i+1}} + \frac{1}{Z^{n+2}}$$

and a suitably altered expression in case n is even, where $\lambda = \frac{\omega(P)}{L(P)}$. In case $s \leqslant \frac{n}{2}$, $b_{s+1} = b_{s+2} = \ldots$ $b_n = 0$ and the previous relations are considerably simplified. Next he shows that

$$\phi\left[\frac{z+z^{-1}}{2}\right] + \tfrac{1}{2}(z+z^{-1})\psi\left[\frac{z+z^{-1}}{2}\right] = z^{v-s}\,q(z)$$

where $q(z)$ is a polynomial of degree s with real coefficients. $v = \left[\frac{n+1}{2}\right]$. With this analysis the problem is reduced to that of finding these coefficients. In the case when $s \leqslant \frac{n}{2}$, this involves the solving of a secular equation. He also derives a number of results concerning the roots of extremum polynomials. Various particular cases and the asymptotic nature of the extremum in particular cases are determined. The following are interesting examples.

(1) If $\int_{-1}^{+1} |B_0\, U_n(x) + B_1\, U_{n-1}(x) + \cdots B_n U_0|\, dx = 1$, then $|B_s| \leqslant \frac{1}{2}$, $s \leqslant \frac{n}{2}$.

(2) If $\int_{-1}^{+1} |P(x)|\, dx = 1$, then $|a_0 A_0 + a_1 A_1| \leqslant 2^{n-2}\,[\,|a_0| + |a_0{}^2 + a_1{}^2|^{\frac{1}{2}}]$, the polynomial for which the extremum is attained being $k^2 U_n(x) + 2k\, U_{n-1}(x) - U_{n-2}(x)$ where

$$\pm k = \frac{|a_0| + |a_0{}^2 + a_1{}^2|^{\frac{1}{2}}}{a_1} \text{ and } \left|\frac{k}{a_0}\right| = \frac{k}{a_0}.$$

(3) If $\int_{-1}^{+1} |P(x)|\, dx = 1$, then $|A_0| \leqslant 2^{n-1}$,

$$|A_2| \leqslant 2^{n-4}\,[n-1+(n^2-2n+5)^{\frac{1}{2}}],$$
$$|A_3| \leqslant 2^{n-5}\,[n-2+\sqrt{(n^2-4n+8)}].$$

[Exact constants.]

In the general case when n is odd the extremum is the root of largest modulus of the equation (in μ).

$$\begin{vmatrix} \sigma_0 & \sigma_1 & \ldots & \sigma_\nu \\ \sigma_1 & \sigma_2 & \ldots & \sigma_{\nu+1} \\ & & & \\ \sigma_\nu & \sigma_{\nu+1} & \ldots & \sigma_{2\nu} \end{vmatrix} = 0,$$

where

$$\frac{1}{\sqrt{x^2-1}}\ \exp\left[\frac{\mu}{2}\sum_0^n \frac{a_k}{x^{n-k+1}}\right] = \frac{\sigma_0}{x} + \frac{\sigma_1}{x^2} + \frac{\sigma_2}{x^3} + \ldots.$$

It is easy to transform II to I by introducing suitable multiples of A_k. In the case of III he has shown that $P(x)$ should be of the form

$$\int_{-1}^{x} (1-x)^\alpha\ (1+x)^\beta\ U^2(x)\, dx, \text{ where } \alpha, \beta = 0, 1.$$

Putting $u(x) = \sum_0^m a_i\, P_{n-i}(x)$. $n = zm + \alpha + \beta + 1$ where the P's are the normalised Jacobi polynomials for the Kern $(1-x)^\alpha(1+x)^\beta$. He derives

$$L(P') = \sum_0^m a_i{}^2 \text{ and } \omega(P) = \sum_0^t \sum_0^B a_i\, a_k\, B_{ik}, \text{ where}$$

$$B_{ik} = \frac{(-1)}{2\pi i}\int_\Gamma \left(1-\frac{1}{x}\right)^\alpha \left(1+\frac{1}{x}\right)^\beta P_{n-i}(x) \times P_{n-k}(x)\ \sum_0^t \frac{a_r}{(n-r)x^{2n-r}} \cdot \frac{dx}{x}$$

where Γ is a contour enclosing the segment $(-1, +1)$. Then the extremum is found to the root of largest modulus of the equation in λ.

$$\begin{vmatrix} B_{00}-\lambda, & B_{10}, & \ldots & B_{s,0} \\ B_1, & B_{11}-\lambda, & \ldots & B_{s-1,1} \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ B_{0,s} & 0 & \ldots & -\lambda \end{vmatrix} = 0$$

Various particular formulæ also are evaluated.

K.V.I.

* * *

Discovery of a New Element.—The element whose atomic number is 87 and which should be one of the alkalis had eluded the search of numerous investigators till to-day. Now H. Hulubei has found evidence indicating its presence in a cæsium mineral (*Comptes Rendus*, 1936, **202**, p. 1927). He made a systematic examination of the X-ray spectra produced by a number of minerals containing mixtures of the alkali elements. A Cauchois type of X-ray spectrograph was used giving a dispersion of 5 X.U. per mm. The K-lines were not made the basis of investigation since the K-lines of the elements neighbouring the one sought for are not well known. The approximate position of the characteristic X-rays

due to the unknown element was calculated by Moseley's rule. The L-spectrum of a number of minerals containing cæsium was carefully examined. The mineral pollucite gave two lines 1032 X.U. and 1043 X.U. in the expected position. These lines were concluded to be the Lα lines of element no. 87. The possibility that the 1032 X.U. line may be Lβ_3 of Hg (1031·4 X.U.)was eliminated by the absence of the stronger Lβ_1 line and by the persistence of 1032 even when an oil diffusion pump was substituted for the mercury pump. The doubt that it may be Lγ_6 or Lγ_2 of Re was similarly removed. The line is not due to Tungsten since the L-lines of the latter are present, faint but distinct from 1032. Besides, this line and 1043 continue even when Lγ_3 of Tungsten disappears. This same fact excludes the possibility of the line 1043 being either of the forbidden lines LiNv(1043·5) or LiNiv(1044·4) of Tungsten. The presence of other weak lines, which after eliminating some possible conicidences, may be identified as the Lβ and Lγ lines of the new element confirms the conclusion that element 87 is contained in small traces in the mineral pollucite. The name Moldavium is proposed for the new element by its discoverer. The present success, in spite of the failure of previous workers, is explained by the fact that present-day X-ray technique allows the detection of an element which forms but one part in 10^7 of a mixture.

T. S. S.

Influence of Ultrasonic Waves on Gels.—The mechanism of the liquefaction of thixotropic gels and peptising effect in general by ultrasonic waves has been studied by H. Freundlich and co-workers (*Trans. Faraday Soc.*, 1936, 32, 966). Liquefaction starts at the gel-air interface which has been strikingly demonstrated by the creaming up of air bubbles in the transparent thixotropic gels of aluminium oxide on irradiation by ultrasonic waves. The mechanism is one of formation and collapse of cavities, since no liquefaction takes place, in vacuum or under high external pressure when collapse or formation respectively of cavities cannot occur. Gelatin in water, glue and rubber in different organic liquids were completely peptised after about 40 to 60 seconds of irradiation while there was no peptisation in vacuum or under pressure. In addition to the vigorous movement to be seen in the two phase systems when irradiated and the heat developed, cavitation also may play an important rôle in the peptisation of gels.

K. S. RAO.

Determination of Gallium in Aluminium.—J. A. Scherrer (*J. Research Natural Bureau of Standards*, 1935, 15, 585) describes two procedures for the determination of gallium in aluminum which are in outline as follows:

(*a*) Joint separation of gallium, vanadium, titanium, zirconium, iron, tin and copper by precipitation with cupferron, purification of the precipitate by removal of tin, copper and iron by means of hydrogen sulphide and recovery of all the gallium, vanadium, titanium and zirconium as oxides. This oxide-mixture is then analysed for the titanium, vanadium and zirconium present therein and the gallium obtained by difference.

(*b*) Direct determination by extraction with ether. A hydrochloric acid solution of the mixed oxides is shaken up with ether when all the gallium passes into the ether layer and all the aluminium remains in the acid solution. The ether extract is then suitably treated to enable the precipitation of gallium in a pure state by means of cupferron.

K. R. K.

BIOLOGICAL SCIENCES.

The Response of Crops to Varying Amounts of Water-Soluble Phosphates in Different Soils.—The poor condition of the vegetation on certain pastures deficient in soil phosphates which leads to the condition called "sweeny" or phosphate deficiency in animals grazing thereon has been the subject of study in its fundamental aspects by O. C. Bryan and W. M. Neal (*Jour. Agri. Res.*, 52, No. 6). Varying amounts of superphosphates (0 to 8,000 lbs. per acre) were added to Norfolk sand, Norfolk fine sand, and Orangeburg fine sandy loam in pot cultures and mustard, vetch and sorghum were used as test plants. It was found that the plants did not respond to a concentration of water-soluble phosphorus greater than 2 parts per million which was equivalent to 1,000 lbs. to 1500 lbs., and 8,000 lbs. of superphosphate per acre in the above three classes of soils respectively. The water-soluble phosphorus in the soil extracts differed greatly as between the soils; with the largest of the above doses, *viz.*, 8,0 0 lbs. per acre, the sand contained 17·2, the fine sand 10·3 and the loam only 1·9 parts per million. The greatest response was on the loam, the fine sand responded less and the sand least. A concentration of 0·5 part per million was necessary to secure appreciable growth of sorghum. The phosphorus content of the plants was proportional to the water-soluble phosphorus content of the soil. Because of the high fixing power of the loamy soil for phosphorus, larger applications of the element were necessary for maximum results.

A. K. Y.

Origin of New Epidermal Cells in the Skin of Frogs.—After the first week of larval life, the increase of epidermal cells in the skin of frogs is enormous but the number of mitoses are not many, pointing to the conclusion that the origin of the cells should be looked for in another source. J. A. Cameron (*Journ. Morph.*, June 1936, 59, No. 2) has determined that the cells of the deeper layers, of mesodermal origin, travel vertically upwards through the dermis and come to lie in the epidermis. This mesodermal origin and subsequent migration of cells which eventually become the epidermal cells of the skin is noticed in the skin of both normal and X-rayed tadpoles, where very few mitotic figures are observed in the epidermis suggesting the deeper mesoderm as the possible source of fresh epidermal cells.

The Morphology of a Nudibranch, *Kalinga*.—In order to furnish a morphological account of a tropical holohepatic nudibranch mollusc, K. V. Rao (*Rec. Ind. Mus.*, March 1936, 38, Pt. 1), has studied the anatomy in detail, of the widely distributed *Kalinga ornata*. In describing the alimentary system, reference is made to the radula, its formula and its movement. The

peculiar histological structure of the hepatic ducts is noted and it is also said that the intestine is the chief absorptive organ. The auricle and the ventricle are free from endothelial lining and it is said that the heart muscles are bathed in blood. The excretory and nervous systems are normally disposed. The ovotestis is recorded to generate sperms first and then the female cells.

The Investigation of the Cleavages in Granites.—In connection with his work on the Bavarian forest granites J. F. Bell (*Eco. Geology*, **31**, No. 3) has suggested an interesting line of work on the interrelationship of fabric and cleavage in granites. From a long time, cleavage has been attributed to such causes as various factors influencing the consolidation of the liquid magma, pressure, arrangement of minerals like felspar and quartz, etc. By following the petrofabric analyses of Sander and Schmidt by using an universal stage, Bell has now concluded that the arrangement of the biotite mica is mainly responsible for the development of joints and cleavages. He has further shown that by this method of investigation, the crushing strength of the granites can also be estimated.

SCIENCE NOTES.

Weight of a Drop as a Function of the Diameter and Material of an Orifice.—Mr. D. L. Das, Lecturer in Physics, Cotton College, Gauhati, writes:

The weight of a drop for an orifice is found to be very nearly the same, when the period of dropping is about ten seconds or more (A. Adler, *Science Abstracts*, Dec. 1935, No. 4896). Experiments were conducted with eight orifices,—four of brass and four of iron—the period of dropping being about 15 seconds. Short uniform tubes of different internal diameters were taken and each tube was bevelled from outside, to a circular knife edge, at one end. Water was allowed to pass from a reservoir through a fine capillary tube and then drop from the orifice, horizontally held. The period of dropping was adjusted by changing the height between the orifice and the constant level of water in the reservoir. The results obtained are given in the table below:—

Orifice material	Orifice diameter (in cms.)	Temperature of water (in °C.)	Period of dropping (in sec.)	Average mass per drop (in gms.)	*Drop mass* / orifice diameter
Brass	0·680	25·7	15·2	0·0966	0·1421
,,	0·620	25·8	15·7	0·0871	0·1405
,,	0·552	25·9	14·9	0·0785	0·1422
,,	0·431	25·9	15·6	0·0654	0·1517
Iron	0·640	25·9	15·3	0·0940	0·1469
,,	0·602	25·8	15·2	0·0879	0·1460
,,	0·492	25·7	14·8	0·0747	0·1518
,,	0·410	25·6	15·0	0·0650	0·1585

The sixth column of the table shows that the ratio of the mass of a drop to the orifice diameter in the case of either material is not a constant, but it slowly decreases and then increases as the diameter decreases within the range of the orifice diameters used. If the masses of drops be plotted against the corresponding orifice diameters in a graph, two separate but nearly parallel curves will be obtained for iron and brass orifices respectively. From the graph it can be shown that if two orifices are used one of brass and the other of iron but both of the same diameter the mass of a drop from an iron orifice is about 1·04 times greater than that from a brass one, for the same rate of dropping and at the same temperature. Thus from a measure of the weight of drop, a relative idea of the surface tensions for different materials can be obtained; the surface tension between iron and water is about 1·04 times that between water and brass.

* * *

Birthday Honours.—The names of the following men of science have been included in the list of the recipients of Birthday Honours:—*Knighthood*: Major-General C. A. Sprawson, Director-General, Indian Medical Service. *C.I.E.*: Dr. F. J. F. Shaw, Director, Imperial Institute of Agricultural Research; *O. B. E.*: Ghulam Yazdani, Director of Archæology, Hyderabad, Deccan; *M.B.E.*: Mr. S. Rajagopal Nayudu Garu, Ag. Chemical Examiner, Madras; *Rai Bahadur*: Mr. B. M. Das, Superintendent, Bengal Tanning Institute; Mr. T. N. Banerji, Professor of Medicine, Medical College, Patna; Mr. S. N. Mukarji, Reader in Mathematics, Delhi University; *Rao Bahadur*: Mr. S. Ramakrishnan, Avl., Professor of Bacteriology, Medical College, Madras; Mr. K. N. Dikshit, Deputy Director of Archæology; *Rao Sahib*: Mr. D. V. Bal, Agricultural Chemist, C. P.; Mr. K. I. Thadani, Botanist, Sind Agricultural Station, Sakrand.

* * *

A Terracotta Toy-Cart in the Indian Museum.—At the ordinary meeting of the Royal Asiatic Society, held on the 6th July, Mr. N. G. Majumdar exhibited a terracotta toy-cart. This unique specimen has been in the Museum for many years. Its findspot is unknown. The cart has six passengers represented in relief including two women, who are all in festive mood and enjoying themselves. The party is engaged in eating and music, as may be seen from a tray containing eatables, a *tabla* and a harp. A similar example of a toy-cart has recently been discovered at Kosam in Allahabad District, and it is very likely that this one also came from the same place. On artistic grounds it may be placed in the Sunga period (about 150 B.C.).

At the same meeting of the Society, Mr. S. K. Chatterji exhibited a set of old Oriya Playing Cards, made of cloth stiffened with a ground made of gum. They are circular in shape and are 2¼″ in diameter. Mr. N. Barwell communicated a paper entitled "Influence of Oriental *Motifs* upon book-bindings in Europe from the 15th to the 18th century".

Maulavi Muhammad Sanuwar Bakht was ballotted for as an ordinary member.

Excavations at Nalanda.—Among the new buildings which have been exposed at Nalanda is a monastery where about 200 metal images and an image with bronze head and agate body have been found. According to Dr. K. P. Jayaswal, President of the Managing Committee, Patna Museum, this monastery was evidently inhabited by monk-artists, as materials for fashioning images have been found in the rooms. Some of the images are of great artistic value.

The system of disposal of the dead in the ancient university has been brought to light by recent excavations. The dead were cremated in a straight row and the ashes were left undisturbed. Many of the smaller *stupas* which were formerly regarded as merely ornamental, had proved to be relic memorials where bones and hair of the deceased saints were placed under double sealings, which in their turn were preserved in clay caskets.

The finds recovered from the excavations at Rajgir in the Maniyar Matha area, specially the terra-cotta with various spouts which are at present housed in the Nalanda Museum, are, according to Dr. Jayaswal, of exceptional importance and such antiquities have so far not been reported anywhere in the world. The Nalanda museum which will soon be extended, will be one of the most important museums of the world, when all the exhibits excavated are arranged and housed properly.

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De Havilland Arch of Seringapatam.—This famous swinging arch, one of the chief attractions of the tourists and a marvel of bridge engineering which was a protected monument, collapsed on 2nd July. The Director of Archæology in Mysore, who visited the scene, considers the restoration of the arch impossible. The Government are considering how best to preserve the remains.

The Arch was built 125 years ago by De Havilland, a French Engineer, attached to the Seringapatam garrison during Tippu Sultan's reign. De Havilland was asked to build a bridge across the Cauvery to facilitate the march of troops and civilian population. Before launching on the scheme to project a bridge without piers and columns, he undertook to construct a specimen bridge in the island. The result was a brick arch with a span of 112 feet, greater than any attempted at that time. This monument of his skill, which withstood all weathers for over a century and a quarter, has been lost for ever.

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The Woodhouse Memorial Prize for 1935 has been awarded to Dr. Mohammad Aziz, D.Sc. (Agric.), of the Wheat Breeding Sub-Station and Rust Research Laboratory, Simla, for his essay on "'Problem of Wheat Rusts in India".

* * *

The Sir Vincent Massey Scholarship for the year 1936–37 has been awarded to Mr. R. C. Lacy, M.Sc. of the Allahabad University for study and research in Plant Pathology.

* * *

Dr. S. K. Banerji officiates as Director-General of Observatories *vice* Dr. C. W. B. Normand, granted leave for three months and two days with effect from July 11 or date of availing.

Dr. C. S. Fox will officiate as Director of Geological Survey of India *vice* Dr. A. M. Heron, granted four months leave from India with effect from July 30.

* * *

Problems of Broadcasting in India.—*The Indian Listener* (June 22) has published a very timely article dealing with the principal problems confronting the development of broadcasting in India. It is an appeal addressed to scientists all over India to co-operate with the Research Department of the Broadcasting Service in determining the nature of the major factors.

To make a success of Broadcasting in India, where an enormous area has to be covered with a dependable signal which will be sufficiently higher than the interfering atmospherics, several technical problems demand close investigation. Both scientific and lay opinion agree that *atmospherics* constitute the first problem. The data available on this point are very incomplete and little work seems to have been done on the distribution of atmospherics on the frequency spectrum. What is wanted is a series of observations of the absolute strength of atmospheric noise at different frquencies. Diurnal and seasonal variations have also to be observed and data tabulated before we can predict with any degree of certainty the probable service area of a station or decide upon the optimum band of frequencies. In order to be able to co-ordinate the results obtained, it is advisable to employ similar methods at all the observing stations. It is suggested that measurements be made immediately after 7–0, 10–0, 13–0, 16–0, 19–0, and 22–0 hours and in each case observations be recorded of the field strength of atmospheric disturbances alone in microvolts per meter, the values being interpreted over 5-minute period on each spot frequency. The variations should be recorded on the complete spectrum between 150 and 20,000 kilohertz.

The collection of data on atmospheric disturbances will be helpful in ascertaining suitable frequencies for transmission. Short-wave experimental transmissions will be made from Delhi, as soon as funds become available for erection of a transmitter, at a number of frequencies, and the results observed. In this connection it is hoped to obtain the help of the listening public as well as the scientific world. The former will be requested to submit reception reports, while scientific workers at different distances from Delhi will be requested to make field strength observations. In this way it will be possible to obtain extensive correlatory curves which will be helpful in founding a short-wave service.

As the suitability of high frequencies for local broadcasting has yet to be proved, the medium frequency band is at present the main vehicle for the diffusion of broadcast programmes. One of the chief difficulties in the drawing up of a suitable scheme of development in this line is the paucity of data on earth conductivity. Since ground-ray attenuation is a function of both frequency and ground conductivity, it is necessary to have reliable data on soil characteristics, over varying types of terrain. It is very desirable, therefore, to have a series of measurements taken at different parts of India over ground ranging from granite and gneiss formations to the pastoral

deltaic areas. This work will be undertaken by the Research Department but co-operation from outside will be very helpful.

* * *

Expeditions to Himalayas.—A Japanese expedition to negotiate the Mount Nandakot in the Himalayas is expected to start the ascent from Spetember 1. This expedition is supported and financed by the Rikkyo (Missionery University) and *Nichi* an influencial daily of Tokyo. This is considered to be of the nature of a trial for a projected expedition to Mount Everest. The party consists of eight members five of whom are graduates. Their previous experiences comprise the conquests of Mount Aliga in Switzerland and Alberta Peak in Canada.

Another expedition to Mount Nanda Devi, consisting of four Americans and four Englishmen planned by the Harward Mountaineering Club and the British America Himalayan Expedition, has already started making preliminary arrangements. Their base camp will be established at a height of 14,000 feet, and the actual ascent from the camp will start either by the end of August or the beginning of September. The expeditionists, all of whom possess considerable mountaineering experience, are equipped with light wind-proof clothing, shoes suitable for deep snow climbing and dried provisions, and they hope to reach the summit of Nanda Devi before the 20th September.

* * *

International Conference on Timber Utilisation, London.—The Second International Congress, organised by the Comité International du Bois', Department for Timber Utilisation in conjunction with its member organisation, the Timber Development Association, Ltd., was held in London from 31st March to 3rd April. 21 countries were represented at the Conference, which was inaugurated by the Earl of Dunmore. Three public sessions were held: (1) Forestry and Timber Utilisation, (2) Timber Research and Timber Utilisation, and (3) The Utilisation of wood waste.

The intimate collaboration in all matters concerning the wide utilisation of timber has already shown very satisfactory results. The various papers read at the Conference served to emphasise the similarity of problems concerning timber in various countries. A main Committee was appointed to receive the reports on the activities of various national organisations for timber utilisation.

It was resolved in principle (1) to continue and intensify international collaboration, (2) to arrange international inquiries, and (3) to organise international competitions. It was considered that all countries represented at the Conference should participate in one pavilion at the World Exhibition to be held in Paris in 1937.

The delegates visited the Prince Risborough Forest Products Research Laboratory, the well-equipped centre of English timber research.

* * *

Inventive Activities in India.—The annual report of the Patent Office reveals a decrease of about 25 per cent. in the number of applications for patents originating from India as compared with those for the year 1934.

While a decrease was noticed in the patents connected with electrical industry, those concerning chemical industry show a marked increase. The subjects investigated cover a wide range such as synthetic resins, drugs, wetting agents for textile processing, investigations on sterols, the manufacture of sulphuric acid by contact process and manufacture of salts by base-exchange reactions. There was a notable increase in patents for surgical and medical appliances. Applications for patents concerning inventions in rail and road transport and aeronautics constituted ten per cent. of the total. Steady progress was maintained with respect to inventions relating to agriculture and allied industries. A number of applications relating to guttapercha and India rubber was received. In the field of glass manufacture, the investigations were mainly directed towards the production of non-shatterable safety glasses, glass suitable for use as a protective coating or glaze upon the interior surface of sodium lamp bulbs where the glass is exposed to highly heated sodium vapour, and the manufacture of certain kinds of boro-silicate glass which are moisture resistant and highly inert to hot sodium vapour and also more transparent than glasses hitherto used for the purpose.

* * *

An Indian System of Physical Culture.—Maharaja Balasahib Pant Pratinidhi, Ruler of Aundh State, a keen follower, an ardent advocate and enthusiastic propagandist of *Surya Namaskar*, an ancient system of Physical Culture adopted for individuals and groups and suitable for all ages and both the sexes, is now touring in Europe to popularise this system. The Ruler of Aundh has made the system compulsory in all the schools of his State and having satisfied himself with the results obtained, he is now advocating the system not only to the peoples of India but also to those outside. The system affords excellent movement to the three vital parts of the body—the abdomen, the chest and the spinal cord. By reviving this excellent system and spreading it, the Maharja has done a lasting service to the cause of Physical Culture. He is the author of a book dealing with the system, originally written in English but now available in many Indian languages.

* * *

The Imperial Institute of Sugar Technology.—The Imperial Institute, which is housed in the Harcourt Butler Technological Institute, was formally brought into being on the 1st July. Mr. R. C. Srivastava, Sugar Technologist in the Imperial Council of Agricultural Research, is the first Director of the Institute. The Teaching and Research Staff consists of about 20 members including three Professors of Sugar Technology, Sugar Engineering and Sugar Chemistry, each assisted by an Assistant Professor, Research Physical Chemist and Biochemist.

The Central Government's contribution to the Institute will be about Rs. 14 lakhs spread over a period of 5 years, which with grants of Rs. 25 lakhs made to the Imperial Council of Agricultural Research for the promotion of sugar research, brings the total Government contribution to Rs. 39 lakhs.

At the recent conference held at Simla to review the progress of sugar research, it was decided to recommend the continuation of the two schemes which have reached the end of their five-year periods, *viz.*, the Deccan Sugarcane Research

Station at Padegoan where considerable work on sugarcane physiology has been carried out, and the scheme dealing with sugarcane diseases carried out at the Imperial Institute of Agricultural Research at Pusa.

* * *

Imperial Council of Agricultural Research.—Sir John Russel, Director of the Rothamsted Experimental Station, and Dr. N. C. Wright have been appointed to conduct the scientific survey of the working of the Imperial Council of Agricultural Research since its inception. Mr. Sethi, Rice and Sugarcane Expert at Shahajahanpur and Prof. Agarwal, of the Lahore Veterinary College, have been appointed as Indian Secretary and Adviser respectively to the Experts, who, it is understood, will arrive in India in November. Their headquarters will be Delhi but will visit a number of research stations in several provinces during their six months' stay in India.

* * *

Properties and Applications of "Everdur".—An alloy of copper, silicon and manganese, whose remarkable properties have procured for it a wide application during the past 10 years, is now available as a British product, following the acquisition by I. C. I. Metals, Ltd., of the manufacturing and selling rights in the United Kingdom. The material is now produced in the form of plate, sheet, strip, tape, rod and wire over a wide range of sizes and tempers to suit individual requirements as well as in ingots for casting. Properties, applications and methods of working are fully described in an illustrated booklet recently issued by the company.

"Everdur" is the first commercial application of copper containing substantial amounts of silicon, and marks a decided advance in the metallurgy of copper alloys in that it combines the tensile strength of medium and low carbon steel with the non-rusting and corrosion-resisting properties of copper. The wide range of its potential applications may be judged from such other desirable properties as a high fatigue limit and good machinability, and from the fact that it is non-magnetic, easy to cast or to work hot or cold, and readily weldable by all commonly used methods. These properties should make possible the replacement of steel with "Everdur" in many applications involving corrosive conditions.—(*Chemical Age*, 1936, **34**, *Metal. Sect.*, p. 36.)

* * *

A Review of the Physiology and Biochemistry of the Sulphur Bacteria.—(His Majesty's Stationery Office. Price 9*d*. net., post free 10*d*.) The importance of sulphur in inorganic nature has long been known but the recognition of the biological significance of sulphur came later. There is, in fact, "a sulphur cycle" which is an expression of the manner in which sulphur passes from inorganic to organic nature and *vice versa*. This circulation is largely due to the sulphur bacteria whose activities are dealt with in this review where reference is made to their economic importance and to the problems concerning them that remain to be solved. One of the major problems is to utilise them commercially, for, up to the present, it is their harmful rather than their beneficial effects that have attracted attention.

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Survey of the Biochemical Activities of the Acetic Acid Bacteria.—(His Majesty's Stationery Office. Price 1*s*. net, post free 1*s*. 1*d*.) It is just 100 years since the conversion of wine into vinegar or acetic acid was definitely declared to be caused by living organisms which at first were thought to be of one species. Later work has shown that there are many species of the acetic acid bacteria, and in recent years a serious attempt has been made commercially to utilise their powers other than in the vinegar industry.

This survey gives a comprehensive account of the nature and variety of the chemical transformations which this group of bacteria are able to effect. Suggestions are made for their application to the production of certain compounds which are difficult to obtain by ordinary chemical methods and for the investigation of problems of potential utility.

* * *

Announcement

Paris International Exhibition, 1937.—An International Exhibition with the support of the French Government will be held in Paris in April, 1937.

The exhibition will be divided into fourteen sections which will again be sub-divided into 75 sub-sections. The subjects to which the different sections will be devoted are: Expression of thought—Literary, musical and artistic, including the scientific discoveries in their applications; social questions including co-operation, hygiene, organisation of intellectual and manual labour; arts and crafts including higher education; artistic and technical diffusion including radiophony, television and cinematography; urbanism including town-building, horticulture and arboriculture; graphic and plastic arts; building industry; interior decoration and furniture; work of art including jewellery, morocco leather work, scientific and musical instruments, books and reviews printing; apparel including dress materials and perfumery; transport and tourism including hotels and travelling requisites; congress, processions and sports; publicity including shop windows and display articles.

Further particulars can be obtained from: Monsieur le Commissaire Général de l 'Exposition Internationale, Paris 1937, Grand Palais, Porte C, *Paris*.

* * *

World Congress of Pre-Historic and Proto-Historic Science.—The second session of the Congress will be held in Oslo on August 3 to 9 this year, in accordance with the decision taken at the first session in London in 1932. The Norwegian Committee of Honour and the Organising Committee announce that they invite all pre-historians and other persons interested, to attend the Congress. Acceptance of this invitation should be sent to Bureau de Congress, Universities Oldskassanling, Oslo. The Organising Committee is putting on agenda several of the more important problems which are occupying the attention of Scandinavian archæologists and which are of international interest. These include excavations of sites dating from the Stone Age of Finmark which set many problems of general interest; rock carvings of the Arctic group to which the most modern research methods have been applied of late years; the remains of farms of the Migration period; the decorative art of the Migration period and finally the textile art of the Viking. Special exhibitions have

been arranged so that members may gain first-hand experience of the subject. Excursions have been arranged to the old Vestfold during the Congress and to Stavenger, Bergen or Trondheim, after the close of the Congress.

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The League of Nations will award the Darling Prize of 1,000 Swiss francs this year for the best work in the pathology, etiology and prophylaxis of malaria. Works which have been published within the last five years as well as unpublished work may be submitted.

* * *

Indian Science Congress, 1937.—The 24th Annual Meeting of the Indian Science Congress will be held in Hyderabad (Deccan) from January 2 to 8, 1937. His Exalted Highness the Nizam of Hyderabad has consented to be the Patron of the meeting. Rao Bahadur T. S. Venkataraman of Coimbatore will be the President.

Papers submitted for reading at the session of the Congress can only be submitted by Ordinary and Full Session Members or through Ordinary Members. No papers are admissible for reading at the session by any one who has not been enrolled as a member by September 15, 1936.

Papers for the Congress should be forwarded together with three copies of an abstract to the President of the Section concerned not later than 15th September 1936. Abstracts are to be typewritten and must not exceed 200 words.

Dr. H. Hyder Ali Khan, Principal, Medical College, Osmania University, and Dr. Muzafferuddin Qureshi, Head of the Department of Chemistry, Osmania University, Hyderabad, have been appointed Local Secretaries.

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We acknowledge with thanks the receipt of the following :—

"Actualités Scientifiques et Industrielles," Nos. 271, 277, 295, 296, 299, 300, 303, 312, 313, 325–327, 329, 333, 335–337, 345–347.

"The Agricultural Gazette of New South Wales," Vol. XLVII, Part 6, June 1936.

"Journal of Agricultural Research," Vol. 51, Nos. 5–7.

"Indian Journal of Agricultural Science," Vol. VI, Part II, April 1936.

"The Philippine Agriculturist," Vol. XXV, No. 1, June 1936.

"Journal of the Royal Society of Arts," Vol. LXXXIV, Nos. 4357–4360.

"The Biochemical Journal," Vol. 30, No. 5, May 1936.

"Journal of the Institute of Brewing," Vol. XLII, No. 6, June 1936.

"Chemical Age," Vol. XXXIV, Nos. 882–885.

"Journal of the Indian Chemical Society," Vol. 13, No. 4, April 1936.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 69, No. 6.

"The Russian Journal of General Chemistry," Vol. VI, Nos. 3 and 4.

"Experiment Station Record," Vol. 74, Nos. 4 and 5, April–May 1936.

"Transactions of the Faraday Society," Vol. XXXII, No. 6, June 1936.

"Indian Forest Records," Vol. I, No. 3 (Silviculture—The Distribution of Sesquioxides, Silica and Organic Matter in Forest Soil, etc.).

"Forschungen und Fortschritte," Vol. 12, Nos. 16 and 17.

"Genetics," Vol. 21, Nos. 1 and 2, Jan. and March 1936.

"Transactions of the Mining and Geological Institute of India," Vol. XXX, No. 3, April 36; Vol. XXXI, No. 1, June 1936.

"Government of India Publications :—

"Monthly Statistics of Production of Certain Selected Industries of India (Department of Commercial Intelligence and Statistics), No. 12 of 1935–36, March 1936."

"Indian Trade Journal," Vol. CXXI, Nos. 1563–1566; Vol. CXXII, No. 1567.

Irrigation Research Institute, Punjab, Vol. II, No. 11; No. 12; Vol. V, Nos. 4 and 5.

Publications of University of Illinois :—

No. 34.—"An Investigation of the Durability of Molding Sands". No. 36—"The Cause and Prevention of Steam Turbine Blade Deposits."

"The Calcutta Medical Journal," Vol. 30, No. 12, June 1936.

"Mathematics Student," Vol. III, No. 4, Dec. 1935.

"Review of Applied Mycology," Vol. 15, No. 5, May 1936.

"The Cambridge Bulletin," Vol. LXXVIII, June 1936.

"Memoirs of the India Meteorological Department," Vol. XXVI, Part V.—Soundings of Temperature and Humidity in the Field of a Tropical Cyclone and a Discussion of its Structure, by K. R. Ramanathan.

Imperial Bureau of Plant Genetics (for Crops other than Herbage):—"Plant Breedings Abstract, Supplement II.—Summary of Report received from Stations in the British Empire," 1932–35, April 1936.

"London Shellac Research Bureau (controlled by the Indian Lac Cess Committee, India), Technical Paper," No. 8.—"Darkening of Lac Solutions and the effect of Oxalic acid thereon," by Lal C. Verman, May 1936.

Do. No. 7.—"Fundamental Physical Properties of Lac, Part III. Electrical Properties" by Lal C. Verman, May 1936.

"Bulletin No. 2 of Indian Industrial Research—A Survey of the Indian Glass Industry," by E. Dixon.

"Nature," Vol. 137, Nos. 3473–3476.

"Journal of Nutrition," Vol. 11, No. 5.

"Indian Journal of Physics and Proceedings of the Indian Association for the Cultivation of Science," Vol. X (XIX), Part III.

"Canadian Journal of Research," Vol. 14, Nos. 4 & 5, Secs. A, B, C & D.

"Ceylon Journal of Science, Sec. E.—Meteorology," Vol. II, Part I.

"Scientific American," Vol. 154, No. 6, June 1936.

Catalogues

"Monthly list of Books on Natural History and Science," June 1936. (Messrs. Wheldon and Wesley, Ltd.).

"Mitteilungen über Neuerscheinungen und Fortsetzungen, 1936," Nummer 3, (Juni), (Messrs. Verlag von Gustav Fischer in Jena).

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences:

June, 1936.—B. N. SASTRI AND M. SREENIVASAYA: *Lipins of Fenugreek* (Trigonella fœnum græcum).—The isolation and fractionation of some interesting lipins are described. S. PARTHASARATHY: *Ultrasonic Velocities in Organic Liquids. Part IV.—Halogen Compounds.*—A study of 15 compounds shows that the acoustic velocity is lowered on introduction of a heavier atom, and also by the presence of a double bond. N. KRYLOFF AND N. BOGOLIÜBOFF: *Upon Some New Results in the Domain of Non-Linear Mechanics.* R. ANANTHAKRISHNAN: *The Raman Spectra of Propylene and Iso-Butane.*—While the lines due to propylene are sharp and well polarised, many of those due to iso-butane are broad and highly depolarised. C. S. VENKATESWARAN: *The Raman Spectra of Selenious Acid and Its Sodium Salts.*—A study of the solid and aqueous and alcoholic solutions shows that the lines broaden out and undergo variations in frequency shift and intensity. It is postulated that the acid exists mainly in an unsymmetrical pseudo acid form in the solid and alcoholic solutions, while in aqueous solutions it is almost wholly converted into the symmetrical true acid form. The dissociation of the acid is weak. S. PARTHASARATHY: *Resonance Curves for a Quartz Oscillator Immersed in Liquids.*—A greater number of diffraction orders was observed, not at the resonance of the crystal but at a point of lower frequency, corresponding to the region of clear resolution of resonance curves. R. K. ASUNDI: *Rotational Analysis of the Ångström Bands at* $\lambda\lambda$ 6080 *and* 6620 Å.U. R. K. ASUNDI AND R. SAMUEL: *On the Dissociation Energy of Carbon Monoxide.* R. S. KRISHNAN: *Dispersion of Depolarisation of Rayleigh Scattering. Part I.—Fatty Acids.*—It is pointed out that the formation of large molecular groups in the fatty acids is probably responsible for the observed dispersion of depolarisation. V. S. RAJAGOPALAN: *On the Structure and Optical Characters of the Nacre in Irridescent Shells.—Part I.*—A microscopic study using plane polarised light and also convergent light supports the optical observations and X-ray studies made on the same. B. K. SINGH AND S. PRASAD. *The Physical Identity of Enantiomers. Part II.* (a) (*The Rotatory Dispersion of* d- l- *and* dl-*forms of Iso-nitrosocamphor and their sodium derivatives.* (b) *The Differences in the Physiological Action of* d- l- *and* dl- *forms of Sodioisonitrosocamphor.* S. PARTHASARATHY: *Diffraction of Light by Ultrasonic Waves—Part II. Reflection and Transmission Phenomena.*—It is made out that transmission (Raman-Nath's theory) and Reflection (Brillouin's theory) are two separate phenomena, superposed on each other, in the case of diffraction of light by high frequency sound waves. B. V. RAGHAVENDRA RAO: *Doppler Effect in Light Scattering in Liquids. Part III.—Polarisation of Light Transversely Scattered by Formic and Acctic Acids.*—The central undisplaced component shows an appreciable degree of depolarisations indicating presence of large clusters of molecule, in these liquids.

Indian Mathematical Society:

December 1935.—C. N. SRINIVASIENGAR: *On a Property of the Focal Surface.*—The paper deals with the exceptions to the theorem: Any surface of the congruence touches the focal surface at the foci of any of its curves. It is explained here that the surface generated by a singly infinite system of curves $F_r[x, y, z, a, \phi(a)] = 0$, $r = 1, 2$ can be guaranteed to touch the focal surface at the focal points of these curves only when the locus of the focal points is not an envelope of the curves. The case of exception is discussed, and some special types of congruences are considered. The following result is deduced from the discussions:

If any singly infinite system (except, in general, one particular system) of surfaces of the congruence possesses a unique (*i.e.*, non-degenerate or single) envelope, this envelope constitutes the focal surface or part of it. HANS RAJ GUPTA: *On Linear Quotient-Sequences.*—Let $\left[\frac{x}{y}\right]$ denote the quotient when a positive integer x is divided by a positive integer y. By a linear quotient-sequence is meant the set of numbers $\left[\frac{Kr + l}{m}\right]$, $r = 1, 2, 3, \ldots$; K and m being positive integers, and l any integer, provided that if l is negative, $|l| \leqslant K$. The following problem is discussed:

Given a set of n positive integral numbers $a_1, a_2, \ldots, a_n$ such that $a_r - a_{r-1} = d$ or $d + 1$, to express, if possible, the given set as a linear quotient-sequence modulo m, where $m \leqslant n$. N. DURAI RAJAN: *Foci in Complex Geometry.*—A discussion of the properties of foci of a curve of class $n-1$ touching all the mutual joins of n points. M. ZIAUDDIN: *Recurrence Formulæ for Bernoulli's Numbers.*—Some new recurrence formulæ for the Bernoullian numbers are investigated with the aid of Symmetric Functions and Determinants. S. S. PILLAI: *On the Nature of the Contact of the Conics* $S = 0$ *and* $S + \lambda T = 0$: If $S \equiv F(x, y) = 0$, $T \equiv (x - x_1)\frac{\partial F}{\partial x_1} + (y - y_1)\frac{\partial F}{\partial y_1}$ where $F(x_1, y_1) = 0$, it is proved that the curves $S = 0$ and $S + \lambda T = 0$ touch at (x_1, y_1) internally or externally according as $\lambda < 1$ or $\lambda > 1$.

March 1936.—V. GANAPATHY IYER: *On Integral Functions of Order One and of Finite Type.*—Let $f(z)$ be an intergral function of order one. Let $0 < \lambda_1 < \lambda_2 < \ldots < \lambda_n \ldots$ be a sequence of numbers tending to infinity. Let $\phi(z) = \prod_1^\infty \left(1 - \frac{z^2}{\lambda_n^2}\right)$, and $f(\lambda_n) = y_n$, $f(-\lambda_n) = y_{-n}$, the sequence $[y_{\pm n}]$ being bounded. Then under suitable hypothesis on $[\lambda_n]$, the following theorems are established by the help of certain lemmas proved in the course of the paper.

THEOREM 1. Let $[y_n]$ in addition to being bounded, satisfy one of the following conditions:

(*a*) the real parts of $\frac{y_n + y_{-n}}{\phi'(\lambda_n)}$ and $\frac{y_n - y_{-n}}{\phi'(\lambda_n)}$ do not change sign as n varies, not all these real parts vanishing; (*b*) the imaginary parts of these expressions do not change sign as n varies, not all these imaginary parts vanishing.

Under one of these conditions, the type of $f(z)$ cannot be less than $l(\phi)$, the lower type of the base function $\phi(z)$. If $M(r)$ and P be the maximum of $|f(z)|$ on $|z| = r$, and the order of $f(z)$, the lower type l is defined as $\underset{r \to \infty}{\text{Lim}} \frac{\log M(r)}{r^\rho}$.

THEOREM 2. Let (a_ν), $\nu = 1, 2, \ldots$ be a sequence of numbers such that $|a_\nu| \to \infty$ as $\nu \to \infty$. Let $E(\lambda, a)$ denote the set of points $z = \pm a_\nu \lambda_n$, $n = 1, 2, \ldots$. Let $f(z)$ be a function of order one and minimal type. Then it reduces to a constant if it is bounded at the set of points $E(\lambda, a)$.

R. C. BOSE: *Two Theorems on the Convex Oval.*—The following theorems are established:

(A) The tangents to a convex oval at the cylcic points cannot all touch the same circle.

(B) All the sextatic points on a convex oval cannot lie on the same conic.

Reciprocating the latter, the tangents to the oval at the sextactic points cannot all touch the same conic. S. S. PILLAI: *On Waring's Problem.*—Let $g(n)$ denote the least value of s required to represent every positive integer as the sum of s non-negative nth powers. Let $l = [(\frac{3}{2})^n]$ and $j = [(\frac{4}{3})^n]$ where $[x]$ denotes the integral part of x. The following results are established—

(*a*) If $n \geqslant 30$ and $[(\frac{3}{2})^n] \leqslant 1 - \frac{l+3}{2^n}$, (1) then $g(n) = 2^n + l - 2$, where (x) = fractional part of x.

(*b*) If $[(\frac{3}{2})^n] \geqslant 1 - \frac{l}{2^n}$, then $g(n) \geqslant 2^n + l + j - 3$.

(*c*) $g(n) = 2^n + l + O(\frac{4}{3})^n$

(*d*) When $8 \leqslant n \leqslant 100$, $g(n) = 2^n + l - 2$.

(*e*) If $K(x)$ denotes the number of n's less than x for which (1) is true, then

$$K(x) \geqslant \frac{\log(\frac{4}{3})}{\log 3} x + O(1).$$

Indian Chemical Society:

April 1936.—SHRIDHAR SARVOTTAM JOSHI AND P. V. JAGANNATHA RAO: *Thermo-Ageing of Colloids. Part I.—Variation of Refractivity.* PANCHANAN NEOGI AND KANAI LAL MANDAL: *Experiments on Resolutions of Co-ordinated Inorganic Compounds into Optical Isomers.—Co-ordinated Cadmium Compounds with Racemic and Active Propylenediamine.* P. C. MITTER AND PHANINDRA NATH DUTT: *Condensation of 3- and 4-Nitrophthalic Anhydrides with Phenol and Anisole.* P. C. MITTER AND S. S. MAITRA: *Studies in the* iso-*Flavone Series.* J. K. CHOWDHURY AND T. P. BARDHAN: *Molecular Size of Cellulose from Different Sources, Part I.* SANT SINGH BEDI AND KARTAR SINGH NARANG: *Quinazolines—Part IV.* N. M. BASU AND T. R. MAITRA: *Investigation on the Effects of Humidity and High Temperature on the NH_2-content of Different Samples of Rice.* KARTAR SINGH NARANG, JNANENDRA NATH RAY AND THAKUR DAS SACHDEVA: *Quinoline Derivatives—Part IV.* RADHA RAMAN AGARWAL AND SIKHIBHUSHAN DUTT: *Chemical Examination of* Cuscuta reflexa, *Roxb, Part III.—The Constitution of the Oil from the Seeds.* DINES CHANDRA SEN: *Studies in the Cyclic Thioketones, Part I.—Synthesis of Non-Polymerised Thiocyclohexanone, Thiocyclopentanone and Their Derivatives.* S. S. BHATNAGAR, M. B. NEVGI AND R. L. SHARMA: *Diamagnetic Susceptibilities of Tin in Di- and Tetra-Valency States.*

Calcutta Mathematical Society:

July 12, 1936.—B. B. SEN: *Note on the Stability of a thin plate under edge thrust, buckling being resisted by a small force varying as the displacement.* M. DE DUFFAHEL: *A reduction formula for the functions of the second kind connected with the Polynomials of Applied Mathematics.* R. C. BOSE AND S. N. ROY: *On the four centroids of a closed convex surface.* M. GHOSH: *The theory of extensional vibration of a beam excited by the longitudinal impact at the fixed end, the other end being free.* N. G. SHABDE: *On Infinite integrals of Bessel's functions.* N. C. CHATTERJEE AND P. N. DAS GUPTA: *On the Irreducible invariant and covariant system of two quaternary Quadrics and two linear complexes.* S. GHOSH: *A note on the vibrations of a circular ring.* R. C. BOSE: *The theory of associated skew rectangular pentagons.* H. S. M. COXETER (CAMBRIDGE): *On S hlafli's generalisation of Napiers Pentagramma Mirificum.* (Communicated by PROF. F. LEVI.)

Meteorological Office Colloquium, Poona:

June 19, 1936.—Prof. K. S. Krishnan of the Indian Association for the Cultivation of Science, Calcutta, addressed the Colloquium on "The Approach to the Absolute Zero".

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

University of Bombay:

Royal Institute of Science.—Dr. T. S. Wheeler, Principal of the Institute, has gone on leave to England till the 26th August, 1936. Prof. G. R. Paranjpe, Head of the Physics Department, will officiate as Principal in addition to his own duties during the absence on leave of Dr. Wheeler.

Dr. N. R. Tawde has been appointed a member of the Editorial Sub-Committee in Physics of the *Bombay University Journal.*

Dr. R. C. Shah will supervise the research work in Organic Chemistry during Dr. Wheeler's absence and is to act as Managing Editor of the Physical Sciences issue of the *Bombay University Journal*, during the absence of Dr. D. D. Kanga on leave.

Dr. S. Parthasarathy, a past student of this Institute, has been awarded the D.Sc. degree of the Bombay University.

University of Calcutta :

The Senate of the University of Calcutta has adopted a very important scheme for affording facilities to students of the University by including military studies as a subject for examination. The scheme was prepared by a Committee appointed by the Senate for the purpose. Military studies will be an optional subject. There will be two examinations—Junior and Senior—and the course for each will cover two years. Each examination will consist of two parts—practical and theoretical. Certificates will be issued on the results of each examination.

University of Mysore:

The Colleges reopened on the 24th June, 1936, after the summer vacation.

Dr. E. P. Metcalfe, D.Sc., F.Inst.P., Vice-Chancellor, who had proceeded on leave, returned on the 29th June, 1936, and received charge of the office from Mr. N. S. Subba Rao, M.A., Bar-at-Law.

Mr. D. S. Puttanna, B.A., F.R.C.S., L.M., D.T.M., Surgeon, has been appointed to act as Principal, Medical College, Mysore, during the absence of Dr. J. F. Robinson, B.A., M.D., F.A.C.S., F.R.C.S. (E), on deputation to Europe.

Extension Weeks organised by the University Teachers' Association were held during the month at Mysore and Nanjangud.

University of Nagpur:

In recognition of the excellence of his work, the degree of the Doctorate of Science of the Edinburgh University has been conferred upon Prof. S. C. Dhar of Nagpur with commendation. His work on Mathieu and Automorphic functions is regarded as a valuable standard work.

Education Board:

The following have been nominated by the Governor-General in Council as members of the Central Advisory Board of Education.—Mr. V. S. Srinivasa Sastri, Vice-Chancellor, Annamalai University; Mr. A. G. Clow, Secretary, Government of India Industries and Labour Department; Lala Shriram, Millowner, Delhi; and Mr. S. A. Roberts of Messrs. Bird and Company, Calcutta.

Krishnakumari Ganesh Prasad Prize and Medal for 1938.

THE Council of the CALCUTTA MATHEMATICAL SOCIETY invites "Thesis" embodying the result of Original research or investigation in the following subject, for the Krishnakumari Ganesh Prasad Prize and Gold Medal for the year 1938.

"Lives and Works of the ten famous Hindu Mathematicians :—

(1) Aryabhata, (2) Varahamihir, (3) Bhaskara I, (4) Lalla, (5) Bramhagupta, (6) Sridhar, (7) Mahabir, (8) Sripati, (9) Bhaskara II, (10) Narayana."

The last day for submitting the thesis for the present award is 31st March 1938. Three copies of the thesis (type written) are to be submitted.

The competition is open to all nationals of the world without any distinction of race, caste or creed.

All communications are to be sent to the Secretary, Calcutta Mathematical Society, 92, Upper Circular Road, Calcutta.

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